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THE

MANOEUVERER,

OR

SKILFUL SEAMAN:

BEING

An ESSAY on the THEORY and PRACTICE

OF THE

VARIOUS MOVEMENTS OF A SHIP AT SEA,

AS WELL AS OF

NAVAL EVOLUTIONS IN GENERAL.

Tranſlated from the French of Mr. BOURDE' de VILLEHUET,

BY THE CHEVALIER DE SAUSEUIL,

KNIGHT of the moſt Noble Order of ST. PHILIP; Captain of Infantry in the French Service, late Captain and Major-Adjutant of the Legion of Tonnere; and Member of the Engliſh Society for the Encouragement of Arts, Manufactures, and Commerce.

Illuſtrated with THIRTEEN COPPER PLATES,

FIVE of which, with many intereſting Obſervations interſperſed through the Work by way of Notes, are the Production of an ENGLISH OFFICER.

DEDICATED

TO HIS ROYAL HIGHNESS PRINCE WILLIAM-HENRY.

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M,DCC,LXXXVIII.

TO

HIS ROYAL HIGHNESS

Prince *William Henry.*

May it pleaſe your ROYAL HIGHNESS!

THE early attention which your ROYAL HIGHNESS hath ſo eminently diſplayed to the welfare of England, in your attachment to Nautical Studies, and the unremitted ardor with which you ſo ſucceſsfully perſevere in the ſame glorious purſuits, muſt afford every true lover of this Country the happieſt preſages of what your future exertions may accompliſh in ſupport of your own fame, and the reputation of the whole Britiſh Empire.

THE People of Great-Britain feel a due ſenſe of their obligations to your ROYAL HIGHNESS, for having ſo nobly relinquiſhed all the allurements of eaſe and pleaſure, to court dangers and difficulties, on the rougheſt

rougheſt Element, in defence of the Nation: agreeing with the general voice of eſteem and applauſe, and conſidering it the duty as well as the intereſt of every individual to ſecond, by all poſſible means, your laudable efforts, the Tranſlator humbly ventures to offer the following Syſtem of Naval Tactics to your peruſal. The high degeee of reputation in which the Original is held by men of nautical ſkill in France, is the beſt apology for preſuming to introduce it here under your ROYAL HIGHNESS's patronage.

THAT your ROYAL HIGHNESS may be no leſs diſtinguiſhed for ſuperior acquirements in Naval Science, than for pre-eminence of Rank, is the ardent wiſh of

Your ROYAL HIGHNESS's

Moſt devoted, and

Moſt reſpectful humble Servant,

LE CHEV. DE SAUSEUIL.

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THE

THE

TRANSLATOR's PREFACE.

FROM the extraordinary reputation which M. BOURDÉ has generally acquired among all Sea Officers of profeſſional abilities in France, and the very diſtinguiſhed manner in which the Academy of Sciences in Paris have expreſſed their approbation of his SYSTEM of NAVAL TACTICS, it cannot be ſuppoſed but that a Tranſlation of that Work muſt prove acceptable, and even uſeful, here, as every care has been taken to convey in Engliſh the judicious principles and reaſoning of the ingenious French Author.—The only difficulty in this undertaking was to guard againſt the poſſibility of miſconception which might ariſe from the multiplicity of technical terms and ſea phraſes, which neceſſarily occur in a Work of this kind. To obviate this, I have, as I proceeded in the Tranſlation, regularly conſulted a Britiſh Naval Officer of experience and capacity, on every doubt I had as to the meaning of the original. From that Gentleman I derived much aſſiſtance; and I would here moſt cheerfully expreſs my acknowledgements to him by name, were I not fearful of offending his delicacy by ſuch a public teſtimony of his liberal information. Hence I flatter myſelf that I may now venture to aſſure the Public, that M. BOURDÉ is rendered into Engliſh with that degree of accuracy which will make his precepts perfectly clear to every reader, and that he will be found as conducive to the inſtruction and improvement of thoſe who are deſirous of applying to Nautical Studies, as he is univerſally eſteemed by thoſe of his own countrymen who are devoted to ſimilar purſuits.

ANOTHER

ANOTHER able Britiſh Officer having tranſlated the greateſt part of our Author, for his private uſe, and added many very ingenious and uſeful Obſervations, with FIVE Drawings of his own, to illuſtrate them, they appeared to us of too great importance to be omitted: therefore, we have enriched the Work with both his Drawings* and his Obſervations, the latter of which will be found printed by way of notes at the bottom of the pages wherever they occurred†.

FROM theſe circumſtances, and the peculiar utility of ſuch Works to a maritime nation like England, we are led to preſume we ſhall not be found to have employed our time in a manner unprofitable or diſſatisfactory to the Public.

MORE intent ſometimes on rendering the true meaning of our Author than on the elegance of the diction, we will not preſume to affirm that we ſhall not be found to have now and then inadvertently made uſe of ſome Galliciſms, inſtead of the exact Engliſh idiom; but we hope none of them are ſuch as to obſcure the ſenſe, and that the indulgent Reader will readily pardon them.

March 1, 1788.

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* Plates I, VII, VIII, IX, & X, of Evolutions, are additional, and engraved from the five above-mentioned Drawings.

† Theſe Obſervations are printed by way of notes in the following pages, *viz.* 41, 59, 60, 77, 80, 81, 96, 97, 98, 99, 100, 101, 102, 107, 124, 131, 230, 244, 245, 250, 256, 257, & 264.

THE

THE

FRENCH AUTHOR's PREFACE.

NAVIGATION hath made greater progreſs in Europe within this century than in all preceding times ſince the diſcovery of the Mariner's Compaſs; and this has been owing to the lights derived from Aſtronomy, Geometry, Geography, and other ſciences which contribute to its improvement. We ſhould not however fondly imagine that all parts of this great Art have been fully inveſtigated and explained, and that there is no room left for farther reſearch or enquiry. The ſureſt obſtacle to the improvement of Arts and Sciences would be to reſt ſatisfied with the knowledge we have already acquired, and forbear all attempts to increaſe it. It is characteriſtical of the activity of the human mind to be continually buſy within its proper ſphere, otherwiſe this activity decays and is ſoon extinguiſhed; as in a machine, of which motion alone is the ſoul, the power and uſe of its ſprings or wheels are frequently deſtroyed by inaction.

ALL our knowledge is compoſed of theory and practice, and the one cannot ſubſiſt without the other: they muſt therefore go hand in hand together; and, in the art of Navigation particularly, they ſhould be inſeparable.

SEVERAL parts of general Hydrography, both theoretical and practical, have been ſucceſsfully explained—The Works of Pere *Fournier*, Pere *Hoſte*, Monſ. *Bouguer*, and Monſ. *Morogues*, have all their peculiar merits. But, Ship-Manœuvres had not yet been ſufficiently elucidated, nor regularly explained, by men of the profeſſion. I have therefore thought neceſſary to conſider this important object with particular attention.

THE Work of P. Hoſte, in which this object is compriſed, was written above ſeventy years ago; it is now ſcarce, and both Manœuvres and Tactics have been conſiderably improved ſince that period. That of M. Bouguer, publiſhed in 1757, includes likewiſe a general Theory of Manœuvres; but, to be able to underſtand this Author properly, a conſiderable degree of geometrical knowledge and experience is neceſſary: beſides, how multifarious are the operations which are to be acquired only at ſea! I muſt indeed confeſs I have derived conſiderable aſſiſtance from ſome of thoſe Works, and the excellent Theory which they contain has been the baſis of my Syſtem: but I have added my own reflections and ideas, and many combinations, which I have had opportunities of making in actual ſervice, with reſpect to ſhip-manœuvres at ſea and in harbour.

I SHALL not attempt to explain here the whole extent of my Work. The accurate and learned analyſis given of it by the Commiſſaries of the Royal Academy in their Report, and which is annexed to this Preface, makes it unneceſſary to enter into ſuch a detail, eſpecially as I could not hope to preſent it with equal preciſion. I ſhall only mention therefore to the Reader my reaſons for dividing the Work into Four Parts.

THE

THE Firſt, conſiſting of Theory, on which the whole Work is founded, is ſo far elementary that it may be readily comprehended by a proper attention on the part of the Reader.

THE Second Part is merely practical. I conſider the Ship in motion at ſea, under ſail, and in every poſſible ſituation. This part of manœuvres, which is the moſt brilliant, requires chiefly great ſpirit and activity in the execution.

THE Third Part contains various Obſervations; and, according to circumſtances, is blended with Practice and Theory. I conſider the Sea Officer, on this occaſion, as an obſerver attentive to every object which can poſſibly contribute to his advancement in theoretical and practical knowledge.

THE Fourth and laſt Part treats of Naval Evolutions and Signals. This is properly the ſcience of the Admiral or Commander at ſea, as well as of every Officer who ſerves in a fleet, a ſquadron, or any other diviſion. Many things may be found in this Part which are not to be met with in other Works.

To the detail of Manœuvres compriſed in this Work, if the Reader will but add thoſe parts which I have not touched upon, only becauſe they have been treated of by others, and were not properly connected with my plan, he will thence eaſily conceive the multiplicity and variety of knowledge neceſſary to form the complete Mariner.

WHEN we conſider our Marine, the extent of our Navigation, and the vaſt number of ſhips which muſt be neceſſarily maintained, even in times of peace, for the ſupport and protection of commerce, we plainly perceive that the number of Officers, of all

ranks, employed in the Navy, muſt be very conſiderable. But were we to examine the capacity of each in particular, we ſhould find very few regularly inſtructed in Ship-Manœuvres, which muſt however be the continual occupation of the Mariner in the courſe of his voyages, as he will neceſſarily be conſtantly in action either to accelerate or retard the motion of his ſhip.

Those who have no other guide but mechanical Routine or Practice, or have learned nothing but from common ſervice, generally find themſelves greatly embarraſſed upon any ſudden and extraordinary event which happens at ſea, particularly in an engagement, where the fire of the enemy, or their own, by dividing the Officer's attention, is apt to diſturb the execution of the manœuvres.

It is in the critical circumſtances of an obſtinate and uncertain conflict that Theory admirably ſeconds the efforts of Practice, eſpecially when we enjoy the advantage of having ſo happily united them by conſtant ſtudy and reflection, that we ſcarcely perceive there are any other combinations neceſſary, to give the proper motion to the ſhip, but thoſe in common Practice.

This Practice, more active in appearance, ſeems to have the advantage over Theory with regard to promptitude and diſpatch; but the latter, more uniform and certain, is more likely to ſecure ſucceſs in whatever is undertaken, than mere Practice unaſſiſted by regular principles. To form the complete Adept in Manœuvres, Study and Practice muſt therefore be united.

The great argument of Mariners who think it unneceſſary to learn the Theory of their Profeſſion, is, that there have been ſome of the ableſt Sea-Officers formed by Practice alone. But who will preſume to aſſert that thoſe men of diſtinguiſhed Genius, whoſe names

names are famous in every harbour, *Tourville*, *Duquêne*, *D'Eſtrées*, *Châteaurenaud*, *Guay-Trouin*, *Barth*, *Ruiter*, *Tromp* *, &c, &c, had no theoretical knowledge? For my own part, I have too great a veneration for the memory of thoſe heroes, to ſuſpect them of ignorance in this eſſential branch of an Art ſo complicated as that of Navigation. Every Maritime State has produced able Mariners; but who are they that we ſhall venture to compare with thoſe pre-eminent Seamen, ſhould we even ſuppoſe them to have acted without any fixed Principles or Theory in all they have ſo happily accompliſhed? Who moreover will now venture to ſay that he poſſeſſes as much ſagacity, penetration, and genius, to perform on occaſion, with equal ſucceſs and glory, what they learned from continual Practice? In a word, who ſhall ever find ſo many opportunities of improvement as they poſſeſſed, by a variety of engagements, and a multiplicity of events, during the courſe of a long offenſive and defenſive Navigation, in which they generally proved ſucceſsful? We rarely ſee a concurrence of ſuch events with all the qualities which were united in thoſe great men, whoſe example would fain be adduced to juſtify the want of application and ſtudy; whole ages are neceſſary to produce Mariners of this uncommon ſtamp.

Now, ſince, with regard to the ordinary race of ſeamen, Practice alone is inſufficient to raiſe them above mediocrity, Theory muſt therefore be united. Without this indiſpenſable union, we ſhall never be able to approach the merits of theſe great models, who chiefly diſtinguiſhed themſelves by thoſe bold manœuvres which generally decide the fate of engagements.

INDEED,

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* To whom might be added *Blake*, *Boſcawen*, *Warren*, and ſome others.

INDEED, experience at leaſt teaches us, that, with equal talents and equal practice, the Mariner who poſſeſſes the knowledge of Theory muſt always be ſuperior to him who is unacquainted with the latter. The man of ſound Theory, with a ſingle glance, will on occaſion direct his ſails and helm much more advantageouſly than the mere practical ſailor, becauſe the former knows how to calculate the degrees of their effects by their motion and obliquity; whereas the mere practical man will make his arrangements at random, or at beſt be guided by mechanical cuſtom; for, every mariner has his own particular method, from which he rarely deviates. Beſides, if the latter hath the good fortune to make his ſhip perform the ſame evolution with the other, it will never be done with the ſame preciſion, nor with equal diſpatch.

LET us figure to ourſelves a Mariner, not only of conſummate experience, but likewiſe furniſhed with all the advantages of regular Theory; can there be a more glorious ſight than to ſee ſuch a man in the midſt of thoſe violent ſhocks, thoſe dreadful convulſions, of contending winds and waves? Without any other reſource but what he finds in himſelf, ſuſpended between life and death, we ſee him alone, holding the fate of his ſhip in ſuſpenſe, ſtruggling to the laſt moment againſt ſurrounding deſtruction, ſkilfully combining all the fury of the element which is ready to ſwallow him, and, with calmneſs and tranquillity, ſubjecting thoſe horrors to the calculations of genius.

WHAT muſt become of the mere practical ſeaman in ſuch a critical ſituation, where his mechanical knowledge can be of no uſe? You may ſee him diſconcerted, pale, ſilent, incapable of any certain reſolution, continually repeating ſome cuſtomary manœuvres, as ill executed, in the general confuſion of the ſhip, as they are directed without principle or deſign.

I WILL venture to make another compariſon, which will ſet this matter in a ſtill ſtronger light. All men in general, for whatever profeſſion they may be deſigned, uſually devote a certain number of years to the acquiſition of profeſſional knowledge. Thoſe who are called to the firſt Offices, as well as the loweſt mechanics, are ſubject to Rules and Principles, in which they endeavour to gain a proficiency. Shall the Mariner alone claim an exemption from all ſtudy and mental application? Shall he fancy that it will be ſufficient for him to ſee what others perform in the courſe of a few voyages and engagements, and ſuppoſe that his eyes will inſtruct him better than all he can learn from ſtudy and reflection in his cloſet?

"A MAN muſt have egregious preſumption and ignorance," according to the Author of the Elogium of *Du Guai Troin*, "to "flatter himſelf with any hopes of ſucceſs in ſuch a Profeſſion "without having carefully ſtudied it." And, indeed, we have many woeful examples of the irreparable errors and misfortunes which have been occaſioned by preſumption in this Profeſſion.

HONOUR, that great and glorious expreſſion, ſo pompouſly pronounced, but ſo ill underſtood, true Honour, I ſay, is not an idle ſentiment which ſupinely ſlumbers in the human breaſt. It conſiſts, with reſpect to a Sea-Officer, in diſtinguiſhing himſelf as much by Science and ſuperior Talents as by Reſolution and Courage.

IT is, therefore, for uninformed Mariners, that, prompted by an impulſe of zeal for the improvement of the Navy, I have compoſed this Work, the fruit of reflection and ſtudy, during the courſe of a long ſeries of Voyages; but I am far from pretending to offer any information to Mariners who have united Study and Practice in the

the completion of their Profeſſional Character—Happy in being of ſome uſe to thoſe who may have occaſion to benefit by my labour, I ſubmit it to the judgement of the reſt. Should any errors have eſcaped me, as I am far from having the vanity of thinking myſelf infallible, it will not give me the leaſt pain to acknowledge and correct them.

Extract

Extract from the Regiſter of the Royal Academy of Sciences, at Paris, *being a Teſtimony of the Merits of this Work.*

MAY 16, 1764.

WE have examined, by order of the Academy, a Work intituled, *Le Manœuvrier*, or the Skilful Seaman; being "An "Eſſay on the Theory and Practice of the various Movements of "a Ship at Sea, as well as of Naval Evolutions; by Mr. BOURDÉ, "Officer in the Service of the French Eaſt-India Company."

We have had but few publications hitherto on the Art of working a Ship at Sea, that are properly calculated for the Inſtruction of young Officers. The Book of Father HOSTE, publiſhed above 70 years ago, and that of Mr. BOUGUER, in 1757, are almoſt the only works of the kind deſerving any notice. The former is nearly obſolete: the latter is an excellent Performance, wherein the moſt ſkilful Officers may find objects very eſſential to their profeſſional improvement. Mr. BOURDÉ, ſenſible of this truth, wiſely availed himſelf of them: but a conſiderable degree of knowledge of the ſubject is previouſly neceſſary, in order to draw from ſuch a ſource. The ſtudy of Geometry, and experience, are requiſite to underſtand that writer with advantage: beſides, there are a multitude of operations, to be acquired only from practice, that an Officer cannot attain but

by a long acquaintance with the Sea, and which do not form a part of Mr. BOUGUER's plan. That Author treats of the Geometrical part only of the *Manœuvre:* to treat of the utility, proper application, and practice of it, was the province of a Practical Sea-Officer; and this is precisely what Mr. BOURDÉ has done in the Work before us.

AFTER having laid down, in a simple and elementary manner, the first notions on the shock of fluids, and on the movement of bodies after percussion, Mr. BOURDÉ examines in what manner the sails are acted upon by the wind, and what is the direction, as well as the true and apparent velocities of the ship in respect to the wind. He clearly demonstrates, that the several velocities of a ship are as the sines of incidence of the wind on the sail, as long as the sail continues under the same trimming or disposition in regard to the keel; and that, in order to remove the quicker from a coast, or from any given line, it is necessary the tangent of the apparent incidence be double the tangent which makes the Course with the Sail; while, at the same time, the Angle formed by the Course and the coast from which a removal is required, shall be equal to the real Angle of incidence. The Author brings, on that occasion, the Table Mr. BOUGUER has drawn up for running with the greatest velocity; but not without observing, however, at the same time, that, out of 28 Articles contained in it, there are no more than eight (about a third part only) which may be of real utility; because, in all the other cases, the Sails would *cover* each other too much. So true it is, that the most sublime Theories stand in need of being submitted to positive experience and practice, before their real advantage and proper application can be determined.

MR. BOURDÉ next considers the action of the Masts and Sails which are on the fore part of a Ship; such as the Sprit-sail, Jib, and Stay-sail, which are set on the Bowsprit, and are advantageous for

for going by the wind and making the ſhip ſteer well, eſpecially when ſhe *gripes* and requires a great deal of weather-helm: experience ſhows that they are more uſeful than the beſt theory can demonſtrate. All the other Sails are equally conſidered, with reſpect to their ſeveral uſes and functions.

The Rudder becomes afterwards the object of the Author's conſideration. He ſhows, by reaſonings as plain as they are natural and obvious, that, in practice, it is the angle of 45 degrees, or thereabouts, which is the moſt advantageous to tack the ſhip; not that of 55 degrees, ſo long inſiſted upon in all books of Geometry. But, in the ordinary conſtruction, the Tiller can hardly admit of being traverſed by 30 degrees. As for the reſt, Mr. Bourdé ſhows evidently, in regard to the Rudder, that it is to be made uſe of as little as poſſible.

The Second Part of this Work contains the application of Theory to Practice, and exhibits a demonſtration of the Evolutions of a Ship. This is the brilliant part of a Seaman's knowledge. An intelligent Officer ought to render himſelf maſter both of his Ship and of the Elements which ſurround him, ſo as to make them contribute to the accompliſhment of his deſign: but he muſt firſt be perfectly well acquainted with their power and their effects. The firſt Problems, offered for ſolution, concern the manner of getting under ſail, when the Ship is riding head to wind where there is no current; to get ready with a ſpring; to either tack or wear a ſhip: to lie to, or otherwiſe diſpoſe the ſails, ſo that, by their oppoſing and counteracting each other, the ſhip may be rendered as it were immoveable: to lie to in a gale of wind, which is done by keeping as cloſe as poſſible to the wind under a ſingle ſail. And, as ſhips are never brought to, but when compelled from ſtreſs of contrary winds, there are hardly any of thoſe operations but are liable to failure. Mr. Bourdé has endeavoured to remedy theſe

defects, by diſcuſſing each ſeparately, and by pointing out, at the ſame time, the methods leaſt liable to ſuch inconveniencies.

The Author's next concern is how to chaſe a ſhip and come up with her by the ſhorteſt method. Several geometricians have treated before of the curves of purſuit, and of the various methods of coming up with a ſhip. Mr. Bourdé adviſes to tack as often as the chaſer ſhall find the veſſel he is chaſing perpendicular to his courſe; provided, however, the chaſer be to leeward of the other: but, if he be to windward, he muſt take care to keep himſelf ſtanding from the veſſel he is chaſing always on the ſame *rhomb* as he did when he began the chaſe; which is the only means of coming both together to the point of ſection of the two courſes.

After having chaſed, the next object is Boarding: therefore all the neceſſary evolutions to ſucceed in boarding, or to avoid being boarded, come after thoſe we have been ſpeaking of. Then Mr. Bourdé treats of the various Anchorings; ſuch as to anchor in fine weather, the ſhip being cloſe-hauled: to anchor with the wind aft: to anchor by ſcudding under a fore-ſail, in ſtreſs of weather: to anchor with a ſpring, in order to preſent the veſſel's ſide ſuddenly to a place or a ſhip meant to be attacked. All theſe operations are firſt deſcribed, next demonſtrated, then cloſed with ſuch judicious reflexions and circumſtances as appear extremely neceſſary.

The Third Part of this Work contains various obſervations on Ships; ſuch as their different parts, their conſtruction, interiour management, rigging and ſtowing, the ſea-ſervice, the neceſſary exerciſes for the manœuvre, and the preparatives for an engagement: laſtly, the complement of men on board, their ſeveral duties, and other important objects relative to navigation. Little as yet had been written on theſe matters, notwithſtanding the important uſe of diſcuſſing, inveſtigating, and improving practical experiments, whence every one is to hope for that experience which is too frequently

frequently to be acquired only by time and particular circumſtances. How many unforeſeen accidents have happened, and might have been prevented, had Officers tranſmitted us their knowledge in that branch, as Mr. BOURDÉ has done!

ANOTHER object, on which Mr. BOURDÉ dwells particularly, is the method of rightly fixing in the *point-velique* the centrical force of the ſails. By the *point-velique* is underſtood that point where a perpendicular raiſed from the center of gravity of the ſurface of the floating line, meets the direction of the impulſe of the water on the Prow of the Ship in a direct courſe before the wind. This point of meeting does not take place in oblique courſes: for which reaſon, in ſuch caſes, there can be no perfect maſting of ſhips, becauſe there is no ſhip but drives and inclines. But it is however very advantageous to place the center of the force of the ſails at that height where an horizontal plane is interſected in the axis of the ſhip by the two lines above mentioned, in paying attention to the oblique courſes, which of all others are thoſe that are moſt frequently requiſite: the reſult of which tends evidently to a general ſhortening of all the maſts, yards, &c, of ſhips, as Mr. BOUGUER propoſes in many places of his Works.

THE Fourth and laſt Part of the SKILFUL SEAMAN is intirely taken up with *An Eſſay on Naval Evolutions*, accompanied with ſome Plates, on which the chief of them are delineated. In that Part are deſcribed, the Diviſion of Fleets; the Orders of Convoy, of Sailing, of Battle, and Retreat; the method of drawing up in any Order, and that of changing it; that of changing from one Order to another, when occaſioned by the ſhifting of the wind, or required by the ſituation of the Enemy; the method of manœuvering a Fleet in its various Orders without changing them; that of avoiding an Action, or of forcing the Enemy to come to one; and that of doubling on the Enemy, and of forcing or traverſing his Line.

All

All theſe various Evolutions have already been almoſt completely treated of by Father Hoste, towards the end of the laſt century: but this Work is become ſo ſcarce, that it is very difficult to be procured. On the other hand, Mr. Bourdé has added to it many things relative to the actual and modern practice of the Art, eſpecially on the Order of Convoy, which is of the greateſt uſe, and yet had been very little noticed by Father Hoste. The Treatiſe lately publiſhed by Mr. Bigot de Morogues contains alſo many remarks on Evolutions; but he has been moſt diffuſive on the uſe of Signals: therefore the Work of Mr. Bourdé will be of ſervice to the Public, even with regard to Evolutions.

From theſe circumſtances, We are of opinion, that this Work is well worthy of publication, both on account of the mathematical principles of manœuvres which are therein explained with perſpicuity and method, as well as the particular experiments and rules of practice with which it abounds; and we conſider it as highly deſerving the approbation of the Academy.

CLAIRAULT & DE LA LANDE.

I certify, that the above Extract is a true Copy of the Original, and conformable to the Judgement of the Academy.

Paris, *May* 23, 1764.

GRAND-JEAN DE FOUCHY,
Perpetual Secretary to the Royal Academy of Sciences.

AN

ESSAY

ON

NAVAL TACTICS.

PART THE FIRST.

On the Theory of Working Ships at Sea.

THE THEORY, of which this Part is compoſed, is nothing but the Demonſtration, ſupported with Proofs, of the effects of every Sail, and of the Rudder, each ſeparately or all together conſidered, both with reſpect to the points where theſe machines are placed in the Ship, and with reſpect to the different diſpoſitions which either are given them in the changes of evolutions, or reſult from their various obliquities, when they preſent more or leſs obliquely their ſurfaces to the action of the water or the wind.

LEMMA.

LEMMA.

1. *If a Body ſtrikes a Surface, it communicates to it all its perpendicular motion.*

DEMONSTRATION.

Plate 1.re

If the Body C, (fig. 1.) meets the ſurface A B, with a motion perpendicular to its middle, or center of gravity D, it will do it with the ſtrength of all its perpendicular motion, which is the produce of its weight by its velocity; and will force it in the direction D G, perpendicular to A B. If the ſame Body meets the ſame ſurface obliquely, and with the ſame velocity, it will impel it in the direction D G, with no greater velocity than that of D E, which is equal to the angle of incidence H F. For, H F expreſſes the perpendicular velocity of the Body H, towards the ſurface: which will appear evident, if we conſider that the movement H D, is compoſed of the two movements H F, and H E; and that there is no other movement but H F, only which can meet the ſurface A B, ſince the other H E, is parallel to it.

But the part H F, of the motion of the Body H, is perpendicular to the ſurface A B: whence it reſults, that the Body H, impels in the like perpendicular manner that ſurface in the direction D G, with a force equal to the product of its weight by the velocity H F. —*Q. e. d.*

CHAPTER

CHAPTER I.

Of the action which Water or Wind have, by their preſſure, on ſurfaces.

Plate 1.st

2. FLUIDS are formed of an infinite number of particles, the minuteneſs of which is the cauſe why, in the firſt inſtant of their action, they communicate, by their ſhock, but very imperceptible degrees of motion: and ſuch is the weakneſs of their operation, that it requires to be repeated a great many times before they can produce any ſenſible effect on the bodies they are to move.

IT is eaſy to conceive, that the more ſpecific gravity a Body is poſſeſſed of, the ſtronger its impulſe muſt be: therefore Water, which weighs nearly eight hundred and fifty times as much as Air, ought to produce (allowing the velocity to be the ſame) an impulſion eight hundred and fifty times as great as the Air would againſt a ſurface of the ſame ſize moved in directions perfectly ſimilar. And when it is known that the impulſe of a fluid depends on its ſpecific gravity, it will be eaſily underſtood that ſuch an impulſe muſt depend alſo on the extent of the ſurface which is ſtruck. For, it is plain that the greater the ſurface is (granting the gravity, the velocity, and the direction of the fluid to be the ſame), the ſtronger the impulſe will be, admitting ſtill the ſame proportion to be kept between the extent of that fluid's ſurface and that of any other ſurface put in compariſon with it; for this only evident reaſon, that a ſurface of twelve feet ſquare will always receive twelve times as much impulſion as would a ſurface of only one foot ſquare. We muſt not forget, however, to obſerve here, at the ſame time,

that ſuch parts of the fluid as ſtrike, find more or leſs difficulty to recoil after the ſhock, according as the ſurface is more or leſs extenſive; becauſe, the greater the ſurface ſtruck, the longer is the continuance of repulſion from their former directions impreſſed on the particles, which, by that very act of repulſion, receive a new direction, by which they are made to loſe for a while the firſt movement they had during their primitive one; whence it follows, that the ſhock of the ſubſequent particles muſt be altered: but, after all, this deviation, from the direct line, of the ſubſequent particles, is ſo trifling, that it may almoſt be looked upon as nothing; ſince there is very little wanting, indeed, but all impulſions ſhould be intirely dependent on, and comparable with, the reciprocal proportions which happen to exiſt between them and the ſurfaces on which they ſtrike; allowing always all other circumſtances to be alike.

3. It muſt be obſerved, that the rapidity of the fluid contributes doubly to the force of the impulſe; ſince every particle ſtrikes with ſo much the more ſtrength as it acts with a greater velocity, and is at the ſame time followed by a greater number of new particles to ſhock the ſurface. So that the greater the celerity of the particles, the greater is the number of thoſe which ſhare the action, and the more powerful is the reſiſtance they oppoſe to their being put out of their direct motion. But, if the Fluid is poſſeſſed of five or ſix times more rapidity, it is evident that every particle enjoys likewiſe five or ſix times more force to ſhock the ſurface which oppoſes the paſſage of them all together; as, on the ſide of the ſurface, there are five or ſix times as many particles to encounter in the ſame ſpace of time: therefore ſuch a ſurface, thus expoſed to the ſhock of the fluid, will be ſtruck with twenty-five or thirty-ſix times more force at one time than at another, ſince there are five or ſix times as many particles employed in the act of ſtriking, and ſupported with five or ſix times as much rapidity. Whence it may be drawn

as

as a concluſion, that impulſions increaſe as the ſquares of velocities; or, in other terms, that they are between themſelves as the ſquares of their velocities, when all other circumſtances are the ſame.

OBSERVATIONS.

When a ſurface is expoſed to the courſe of a fluid, it is indifferent whether we conſider that fluid as ſhocking the ſurface, or the ſurface as moving in the fluid: or, again, whether we conſider the fluid and the ſurface as having each their reſpective ſhare of the velocity with which that ſurface receives the impulſe of the fluid.

4. When the Wind has little velocity, its action is obſerved to be but faint; but, when moving with rapidity, then it becomes capable of producing the greateſt effects. This is not difficult to be conceived; for, if to the action of every particle of air, which is ſtronger on account of its increaſed celerity, be added a greater number of particles ſtriking at the ſame time, it is evident that its force will increaſe as the ſquare of its velocity; which has already been demonſtrated.

The ſame, therefore, may be ſaid of Water, the impulſe of which is almoſt like that of a ſolid when it acts, or is acted upon, with a great rapidity of motion. Whence we muſt conclude, that if that water meets perpendicularly a body which preſents to it a great ſuperficies, ſuch a body muſt have the greateſt ſolidity to be able to reſiſt it.

5. This principle is confirmed by experience. For, a ſhip which drives to leeward does not divide the fluid with her ſide in a direct line; there is always ſome obliquity in the direction ſhe purſues by her act of dividing. Now, this obliquity proceeds from the little reſiſtance ſhe experiences from the fluid either at her ſtem or at her ſtern. So that ſhould ſhe be but ever ſo little driven to leeward, ſhe glides always obliquely on the column of water which

oppoſes her, under her lee, in following a line more or leſs cloſe to the direction of her length, than to the perpendicular which may be conceived to be drawn as lateral to her keel.

6. We have, as yet, ſpoken of the impulſe of fluids upon ſurfaces only, when conſidered as perpendicular: but, when that impulſe becomes oblique, it is plain it muſt receive a great deal of diminution; ſince the motion of every particle will be diſcompoſed on account of its acting only by its motion perpendicular to the ſurface, as has been demonſtrated (*fig.* 1.), where the body H, may be conſidered as a particle of a fluid, the impulſe of which is proportionably leſs as the ſine of the angle of incidence H D F, is diminiſhed: ~~therefore~~, smaller so that in this preſent caſe, when we conſider the particle H, as a body, its impulſe will be in the proportion of the different angles of incidence, which always expreſs the reſpective velocities, as ~~theſe~~ being conſidered only in a direction perpendicular to the ſurface.

7. If, inſtead of a particle only, the whole ſurface is conſidered as expoſed to the courſe of all thoſe which compoſe a fluid; it will appear evident, from what has been ſaid, that the ſurface E F, (*fig.* 2.), which is oblique to the courſe of the fluid, preſents to that fluid, a leſs ſurface than it would if it were perpendicular to it, like A B. So that each particle produces a leſs ſhock, and leſs in number are the particles which are at the ſame time contributing their ſhare to the ſhock. Now, as theſe two cauſes of diminution follow the ſame proportion, it reſults, that the impulſions of fluids are between themſelves as the ſquares of the ſines of incidence. Therefore, as ſoon as the impulſe of a fluid, which ſtrikes a ſurface perpendicularly, is known; you have only to diminiſh that impulſe, when it ſtrikes the ſurface obliquely, in the ſame proportion as the ſine total I K, is to the ſquare of the ſine of incidence L K.

Plate 1st

The ſurface A B (*fig.* 2.) receives all the direct impulſe of the fluid which ſtrikes it perpendicularly, and which is contained between

tween C D: but, the ſame ſurface, preſented obliquely to the fluid in the direction E F, will receive but a part of the impulſe, which will be proportional to the ſine of incidence K L, compared with the ſine total I K, of the direct effort of every particle contained between the parallels E G, and F H, which incloſe a much leſs ſpace than the firſt, A C, and B D. Whence we may eaſily conclude, that the diminution of the impulſe of the fluid has diminiſhed on two ſides, and has conſequently followed the proportion of the ſquare of the ſine total I K, to the ſquare of the ſine of incidence L K; for, there is a leſs number of particles employed in ſtriking the ſurface, and poſſeſſed of a ſmaller degree of velocity.

COROLLARY.

8. It follows, that we ought not to be ſurpriſed to ſee the velocity of a ſhip diminiſhing conſiderably when, after having run with the wind aft or large, the veſſel is hauled cloſe on a bowline. For, it is evident that all the ſails which can poſſibly be ſpread in this laſt direction will receive but very little impulſe, on account of their great obliquity to the wind, with which they cannot make an angle more open than 30 degrees, and ſometimes much leſs, as will be demonſtrated hereafter. So that the impulſe has diminiſhed, in proportion as the ſquare of the ſine total is to the ſine of incidence of 30 degrees; that is to ſay, as 4 to 1. Therefore, the ſails, receiving but a very faint impulſe, can neceſſarily communicate to the ſhip but a ſmall motion; a motion which is ſtill enfeebled by the reſiſtance of the water on the prow; which reſiſtance increaſes, on one hand, by the inclination of the ſhip, and on the other by the greater ſurface which ſhe preſents to the water in the direction of her length; to which muſt be added, again, the decompoſition of the abſolute effort of the ſails, the lateral part of which is now become much greater than the direct. By all

all theſe means we ſee, that the rapidity of the ſhip's way is already diminiſhed from three evident cauſes; to which a fourth may ſtill be added; and is this: that if the ſhip has an inclination to the horizon (as this never fails to happen in oblique courſes, and as we have already hinted), and if the wind has ever ſo little force, there will reſult again, from that new circumſtance, a fourth cauſe of diminution of impulſe of the wind on the ſails; becauſe, in ſuch a caſe, the ſails follow that particular inclination of the ſhip called *heeling:* and this diminution of impulſe will follow this particular proportion, *viz.* that in ſuch a direction the ſquare of the ſine of incidence will be ſmaller than that of the ſine total. Therefore, we ſee that the abſolute ſine of incidence diminiſhes in a twofold proportion, and receives that diminution from the compound ratio of the proportion which the ſine total bears to the two ſines of the obliquity of the yard with the wind, and of the inclination of the ſail with the wind.

REMARKS.

9. The impulſe of the wind on the ſails being continual, muſt neceſſarily communicate to the ſhip, degrees of velocity which, from inſtant to inſtant, are increaſing, until there happens to be an equilibrium between the impulſe of the wind on the ſails and the reſiſtance of the water on the prow; obſerving alſo, that in the courſes where the ſhip ſails with the wind abaft the beam, the firſt moment when the wind ſtrikes the ſails, is the time when its impulſe is greateſt, and the reſiſtance of the water the weakeſt; becauſe, at that inſtant, the ſhip does not yet move in the fluid, not having yielded to the power of the wind: but, in a few moments, the ſhip gathering way, her velocity increaſes, whence the reſiſtance of the water on the prow increaſes, alſo conſiderably: then the impulſe of the wind on the ſails is proportionably decreaſing; becauſe the ſhip receding,

ceding, as it were, from the wind, muſt of courſe leſſen its power on the ſails. Thus the accelerating force is inceſſantly leſſening from two cauſes; the firſt from the wind ſtriking the ſails with leſs force, and the ſecond from the greater part of its impulſe being deſtroyed by the reſiſtance of the water on the prow: a reſiſtance which increaſes in proportion as the ſhip's way accelerates; for, this oppoſition of the water is as a deduction from the effort of the wind; ſince, by its reſiſtance, the water renders part of that effort ineffectual. Therefore, the rate of ſailing will be the greateſt poſſible when the impulſe of the wind upon the ſails ſhall be ſo diminiſhed, and the reſiſtance of the water on the prow ſo increaſed, as that the two forces acting in contrary directions are in a perfect equilibrium. Hence we are to conclude, that the veſſel muſt now enjoy a conſtant and uniform motion; for, the ſhip advances as if ſhe were not ſubject to the action of any exterior force, the wind no longer having power to increaſe her velocity, becauſe the reſiſtance of the water on her prow prevents it; and, on the other hand, the impulſe of the wind hinders the water, by its reſiſtance, from retarding her courſe.

OBSERVATIONS.

10. If a ſhip runs on a line perpendicular to the direction of the wind, the impulſe on the ſails is always the ſame, becauſe ſhe does not recede from the point from which the wind blows: but, when ſhe ſails cloſe hauled, the impulſe muſt be ſtronger; becauſe ſhe runs to windward, and draws nearer to that point. So that if the rate of the ſhip's ſailing be great, the apparent angle of incidence diminiſhes in proportion to the two velocities, *viz.* that of the wind, and that of the ſhip.

The moment a ſurface which is ſuſpended, or afloat, is ſtruck by a fluid, that is the time of the greateſt impulſion (if it were not in motion before), and of the greateſt reſiſtance of the ſurface.

CHAPTER

CHAPTER II.

Of the Center of Gravity.

11. EVERY ſolid has a center of gravity; that is to ſay, a point on which, it being ſuſpended, it will have a perfect equilibrium in any poſition. And on that point all the gravity of the body is united. For example, in the rectangular parallelepipedon A B, (*fig.* 3.), the center of gravity of which is exactly in the middle G; if it be ſuſpended from that point, as from G, to D, it will always be in equilibrium; becauſe that ſolid being conſidered as regular, one of its halves muſt exactly balance the other; and were it not regular, the finding of this center would be much more complicated. Without engaging, therefore, in abſtract difficulties, it will be ſufficient, for our purpoſe, to make it appear that the center of gravity of a body heavier at one extremity than at the other, lies always in the heavieſt part, with reſpect to the point which marks the middle of the length of the body. If to the ſolid A B, which is ſuſpended in a perfect equilibrium by its center of gravity G, be added a weight E, in the center of the part A G, the equilibrium will then be loſt, as it will increaſe the weight of this part, which will then overweigh the other half B G, by all the weight E, of which the part B G, becomes by ſo much lighter. To find, then, the center of gravity, which is changed from G, to I, we muſt divide reciprocally to the weight of the two bodies, A G + E for the one, and B G, for the other, the interval F H; for it may be ſuppoſed that this half A G, of the parallelepipedon (*fig.* 3.) *plus* the weight E, is a body ſuſpended by the center F, of the part A G;

and

and that this point is the extremity of a lever F H, infinitely light, which bears alſo, at the other extremity H, taken for the center of the other part B G, all the weight of that part: ſo that, if the body A G + E, weighs four times as much as the other weight B G, we have but to make the interval F I, the fourth part of the other I H, and the point I, will then be the center of gravity required of the ſolid A B + E, and the two bodies ſuſpended by that point will be in perfect equilibrium; for the weight A G + E, is four times as heavy as the other B G; but it acts with an arm of a lever F I, which is only the fourth part of the other I H; therefore the two weights ſuſpended by the point I, will preſerve a perfect equilibrium, in whatever ſituation they may be placed, as they make, in fact, both but one, the heavineſs of which may be ſuppoſed united in the ſingle point I, which is the center of gravity ſought.

COROLLARY.

12. It follows, from what has been demonſtrated, that a long lever is productive of a greater effect than a ſhort one, when both are actuated by the ſame force; whence we muſt conclude, that the longeſt lever, or (what is the ſame) the greateſt diſtance from the *fulcrum* or point of ſupport, is proportional to the greateſt weight.

It is very eaſy to be convinced of this truth, if we make one of the two following proportions: firſt, thus; the ſum of the two weights A G + E + B G : F H : : B G : F I; or : : A G + E : I H.

We have ſuppoſed the weight A G + E (*fig.* 3.) to weigh four times as much as the other B G, which I ſuppoſe to be two pounds; ſo that the ſum total will be ten pounds. Then ſay: Ten, the ſum of the two weights, is to the whole lever F H, as two pounds is to the leſs part F I, of the lever divided into five equal parts: ſo that, if F I, is equal to two feet, I H, will be equal to eight feet, and F H, equal to ten feet. But we have alſo this

proportion to make; *viz.* TEN pounds, the ſum of the two weights, is to ten feet, the length of the whole lever, as eight pounds are to eight feet; but, admitting the diſtance F H, to be ten feet, the diſtance F I, is found to be two feet, and that of H I, eight feet; which demonſtrates, that a power of two pounds on a lever of eight feet, is equal to a power of eight pounds on a lever of two feet; for, the product of the extremes, in both the one and the other proportions, is equal to that of their means.—*Q. E. D.*

IT ought alſo to be obſerved, that the center of gravity of a ſolid follows always the greateſt weight with reſpect to the middle G, (*fig.* 3.), ſince the point I, is four times as near the center F, of the heavieſt body as it is to the center H, of the lighteſt body.

COROLLARY.

13. IT follows, that the center of gravity A, of a ſhip (*fig.* 4.) is always before the point C, which is the middle of her abſolute length; for, the fore part B C, having more capacity than the after part C D, muſt of courſe have alſo more weight: therefore, it carries the center of gravity C, forward, in proportion to its greater weight (which in large ſhips is from fifty to eighty tons), and to the interval there is between every center of gravity of each particular part, both forward and aft.

REMARKS.

14. WHEN at ſea, and the ſhip loaded, the center of gravity may well be ſuppoſed to be no longer ſubject to change, unleſs the cargo be moved.

BUT we muſt not neglect to obſerve, that, as experience ſhows it, the fore or after part of the bottom of a ſhip plunges and labours more and more, in proportion as the wind acts with more or leſs force

force on the ſails; becauſe ſhips are generally not maſted according to the *point velique:* * ſo that a ſhip which has the center of the effort of her ſails ill-placed, draws always more water forward or aft, when the wind acts powerfully on her ſails, than when ſhe is at eaſe under her burthen.

THEOREM.

15. *The center of rotation, or the point on which a body turns freely, is always on the other ſide of the center of gravity of that body, with reſpect to the point on which the moving force is acting.*

DEMONSTRATION.

If the body B D, (*fig.* 5.) be ſtruck in its center of gravity G, when it is in a perfect ſtate of reſt, it is evident (n. 1.) that the two extremities B, and D, will advance equally on parallels: but, if it is ſtruck in the point F, diſtant from the center of gravity by any mobile ſuch as A, when it is ſubject to no friction, it will then have two motions with reſpect to its center of gravity G, on which are collected all the weight and the reſiſtance. For, that center, not being held by any thing, is moved in the direction G *g*, parallel to the direction A I, of the effort of the mobile A, which ſtrikes the

* Let an horizontal ſection of the ſhip, at the exact height of the floating line, or where the ſurrounding filaments of water encompaſs the bottom, be ſuppoſed; from the center of gravity of this ſurface, let a perpendicular be raiſed, and continued till interſected by the direction of the impulſe of the water on the prow, in ſailing exactly before the wind; and where theſe two lines ſhall cut each other, there is the *point velique*, and where the center of effort of all the ſails ſhould be placed.

the body B D, in the point F. So that the part B G, of that body receives the ſhock of the mobile A, which makes it paſs from F to *f*, conformably to the direction of its motion A I. And as the other part G D, of the ſame body ſhares that motion but in proportion as its parts are leſs diſtant from the point F, of percuſſion, (ſince the neareſt parts of that point receive the greater ſhare of the action,) in proportion as they remove from their firſt ſituation, they all deſcribe, by the firſt effect of the ſhock, parallels B *b*, G *g*, and D *d*, to the direction A I, of the effort of the mobile A. Theſe parallels are greater as they are more diſtant from the part ſhocked, and from its extremity B; becauſe the reſiſtance which the body B D, makes againſt receiving the motion, cannot be in equilibrium with that which the power A, takes to loſe part of its own motion, but as much as the two reſiſtances are equal and directly contrary: therefore, the body B D, in yielding to the impulſe of the mobile A, does not oppoſe to it a reſiſtance equal to its ſhock; it muſt then change its place and ſituation, in turning on the point R, marked by the meeting of two lines D R, and *d* R, drawn from the center of gravity of the body B D, in thoſe two ſituations, before and after the ſhock; and as the circular motion of the body B D, takes its riſe always round the center of gravity, it is eaſy to conceive that the center having taken the velocity G *g*, it muſt continue to move equally in the ſame right line prolonged; and that the body having begun to turn, it muſt continue to do the ſame round its center of gravity, although, at the ſame time, it be carried in the direction A I, on the parallels B E, and D H, as long as the force which puts it in motion ſhall exiſt. But, it muſt be remarked that, in proportion as it ſhall remove from its firſt ſituation B D, it will loſe all the relations it had in the principle of motion, with the point R; that is to ſay, that the point G, being tranſported to *g*, in the firſt inſtant of the ſhock, it will continue in the ſecond and the following inſtants to be thus tranſported on

the

the ſame line and in the ſame direction: therefore, the point of rotation R, will change in proportion as the body B D, removes from the ſecond ſituation *b d*, to take another E H; for the line H K, will cut D R, of the firſt ſituation B D, in a point K, nearer the point from which the body was moved; and although the point of rotation R, be continually changing during the time of motion, it remains always on the other ſide of the center of gravity, with reſpect to the point of percuſſion, till at laſt the body B D, be ſo much turned, that the effort A I, may paſs through the center of gravity G, in the direction D B; then the body D B, will ceaſe to turn round a point ſituated on the part G D, prolonged, and will turn ſucceſſively on different points of the part G B, which will then have paſſed to the oppoſite ſide.

REMARKS.

16. If the force of the mobile A, (*fig.* 5.), employed to turn the body B D, be greater or leſs, the velocity G *g*, of the center of gravity will be likewiſe increaſed or diminiſhed in proportion as the mobile ſhall act with more or leſs power. Conſequently, when the body B D, changes its ſituation, the angle it will make with its firſt poſition will be proportional to the motion G *g*, or to the force employed in the ſhock, ſince they are correſpondent to one another. Therefore, all other circumſtances being the ſame, the rapidity of the circular or turning motion will be always in proportion to the force employed to procure it.

17. A method of increaſing the rapidity of motion, and the angle of rotation, is to make the power A, (*fig.* 5.) act on a point more diſtant from the center of gravity G, than the given point F; for, it is clear, that if the diſtance G F, be two or three times augmented, the other diſtance G R, from the center of gravity to the point of rotation, will become two or three times leſs; and the

ſides

ſides of the angle G R *g*, becoming conſequently ſhorter, it follows, that the angle will of courſe be more open in the ſame proportion. Therefore, it may be demonſtrated that there are two ſure and infallible methods of augmenting both the angle and motion of rotation of a body: the firſt, is by employing more force in the percuſſion, in order that the angle G R *g*, ſhould be as much increaſed as is the ſide G *g*, which ſubtends it.

THE ſecond, is to apply the force at a greater diſtance from the center of gravity of the body you wiſh to turn: for, in augmenting F G, G R, is diminiſhed; and the more the ſides which form an angle are ſhortened (the ſide which ſubtends it ſtill remaining the ſame), the more the angle is augmented. So that the angle of rotation is in a compound proportion both to the force employed, and to the diſtance of that force from the center of gravity: this angle is then, as the produce of that force multiplied by F G. Although the body be perfectly free, and take a direct motion G *g*, we muſt conſider its center of gravity G, as the point of ſupport, or F G, as the arm of a lever; and the angle of rotation B R *b* is always proportional to the *abſolute** force, employed in the percuſſion.

18. LET us conſider the body B D, (*fig.* 5.) as being expoſed to the action of ſeveral forces at the ſame time, and it will ſoon appear that the angle of rotation will be proportional to the ſum or difference of the abſolute forces, according as they tend to turn the body B D, in the ſame or in contrary directions.

IF the operative forces directly counteract each other, it is plain their abſolute effect, with reſpect to the center of gravity G, muſt be firſt ſought, and then deduct the exceſs of one from the other: this

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* By the term *abſolute force*, we underſtand the force employed to turn the body, multiplied by the diſtance F G, from the center of gravity.

this being done, the angle of rotation will be in a ratio to that exceſs; whereas it will be proportional to the ſum of the forces employed, if theſe act in concert, and in the ſame manner, to augment it.

But if you take no notice of the angle of rotation, and wiſh to conſider the center of gravity only as being tranſported from G, to *g*, it is not neceſſary to ſeek the ſum of the abſolute forces of the acting powers: you have but to conſider the forces in themſelves, and then G *g*, will be found proportional to either their ſum or their difference, according as they contribute to produce the ſame effects, or as they are oppoſite in their efforts.

Are thoſe forces equal between themſelves, and do they act in contrary directions on the extremities A, and B, (*fig.* 6.) of the body A B, and on arms of equal levers? Then it is evident the angle of rotation will be double what it would be, if the body was ſtruck by only one of theſe forces, and turned on its center of gravity: ſince the two parts, which ſtand ſeparated by the center, are ſtruck equally, and at the ſame time, by forces which act perpendicularly in contrary directions.

To prove this, obſerve that the equal powers S, and T, are acting at the ſame time on the body A B, with equal levers G K, and G F: ſo that the extremity B, paſſes to C, at the ſame time as the extremity A, paſſes to D; and thereby the center of gravity G, remains as if it were fixed in the ſame point which ſerves as a center of rotation; for, if one of the acting forces removes it from its firſt ſituation, the other, in oppoſing an equal force, will replace it.

If the power T, exceeds the other S, it is evident the center of gravity G, will be tranſported towards *g*, in proportion as the force T, exceeds the other S; then the body A B, could turn no longer on the center of gravity G, (n. 15.), but on another point E, which would be on the other ſide of the center of gravity G, with reſpect to the point of percuſſion.

OBSERVATIONS.

OBSERVATIONS.

If the body A B, (*fig.* 6.) were ſtruck at the two points K, and F, by two mobiles S, and I, exerting equal powers, with reſpect to the center of gravity G; it is plain that the body A B will be carried on parallels, ſuch as I T, and S H, and that the ſum of the two powers will act on the center of gravity G, ſince they are equal in every reſpect.

THEOREM.

19. *A ſail acts always two ways on a ſhip, when it is not perpendicular to her length.*

DEMONSTRATION.

To prove it, we have only to conſider the ſail A B, (*fig.* 7) oblique to the ſhip and to the wind W, to be convinced (nn. 1, 7.) that it is impelled in the direction C D, with a force expreſſed by the ſquare of the ſine of incidence of the wind upon the ſail. Therefore, what we are going to ſay here for the preſent caſe is to be underſtood as applicable in all others, in which the ſail ſhall not be perpendicular to the length of the ſhip; for, then, ſhe would go but in the direction of her length from C, to E, or from C, to F, according as the ſail might be full or a-back.

If C D, be equal to the impulſe of the wind upon the ſail, as expreſſed by the ſquare of the ſign of incidence A V, we have only to form the right-angled parallelogram G H, to be convinced that ſuch a direction is compoſed of the two effects C H, and C G, which it produces with reſpect to the body E F, upon which it acts in impelling it in the direction C D.—*Q. E. D.*

REMARKS.

REMARKS.

THE more the yard A B (*fig.* 7.) ſhall make the angle A C E acute, the more the effect C H will augment, and the other C G diminiſh; for, the more the angle A C E becomes acute, the more its equal D C H or C D G (n. 22) will be acute alſo; ſo that the perpendicular C D, which is in the direction of the center of the yard, will approach more to the other perpendicular C H, in the direction of the length of the ſhip E F; which cannot happen without increaſing the effect of the ſhip falling off in the direction C H, and increaſing likewiſe the cauſe C D, which follows in that increaſe the ſame proportion as the ſquare of the ſine of incidence augments (nn. 1, 6, 7.). But this increaſe of the impulſe C D is not ſufficient to preſerve the effect of the ſail in the direction of the keel C G. On the contrary, it diminiſhes in the proportion of the decreaſe of the ſine A C E or C D G; whence it follows, you never can augment the impulſe of the wind by ſhifting the ſituation of the ſail, when it is properly trimmed, without leſſening the rate of ſailing (n. 28.), when neither the ſhip changes her courſe, nor the wind ſhifts its ſource or direction.

20. IT might, in the ſame manner, be demonſtrated, that the more open the angle A C E of the ſail is with the keel, the more its effect C G, in the direction of the ſhip's length, will increaſe in the ſame proportion as the increaſe of the ſine of that angle, when the impulſe of the wind upon the ſail is the ſame; for, the ſines of the angles are in proportion to their oppoſite ſides in the triangle C D G, of which the angle C D G is equal to the angle A C E.

IF the impulſe augment alſo (n. 3.), the two effects C G and C H will augment proportionally.

21. IF the ſail A B receive the impulſe of the wind B on its anterior ſurface, it would ſtill act in two ways on the ſhip, by

forcing her firſt a-ſtern in the direction C F, and then to leeward in the direction H C: To prove this, reverſe the parallelogram, by tracing it on the after part of the yard A B, which looks to the ſide F, and uſe the ſame reaſoning.

THEOREM.

22. *The angle* A C F (*fig.* 8.) *formed by the yard* A B, *and the keel* F C *of the ſhip, is equal to the angle* D C E *comprehended between the perpendiculars* D C *to the yard and* E C *to the keel, in the like manner as the angle* C D G.

DEMONSTRATION.

THE angle A C D is right, ſince C D is perpendicular on A B: the other angle F C E is right alſo; for C H is perpendicular on F C I; therefore, the arc A D is equal to the arc F H; and if, from theſe two equal arcs, be taken away the common one F D, the remainders A F and H D will be equal: becauſe, when equals are taken from equals, the remainders muſt be equal.—*Q. E. D.*

SECONDLY, the angle C D G in the parallelogram G E is alternate to the angle D C E: therefore it is equal to it; therefore it is equal to A C F.—*Q. E. D.*

COROLLARY.

23. IT follows that the angle B C H is equal to the angle D C F; for, if, from the two equal arcs A D and B D, be taken the other equal arcs F A and D H, the remainders F D and H B will be equal.

REMARKS.

REMARKS.

24. THE few principles of Geometry here given, and which will be found of great ſervice in the ſequel, ought not to diſcourage. When we make uſe of them now, it is only that we may eſtabliſh principles as ſimple as they are ſure and fundamental, and leave nothing to doubt or conjecture in the following part of this Theory, which is in itſelf very abſtruſe. We ſhall however be obliged to uſe again a few more demonſtrations of this kind.

CHAPTER III.

Of the moſt advantageous angle the ſails are to make with the keel and the wind, in order to obtain a ſailing of the greateſt rate, on an oblique courſe.

25. IN moſt ſhips the ſails make with the keel an angle A D R (*fig.* 9.) of 40 degrees, or thereabouts (ſome more, ſome leſs), when cloſe hauled. We are now to undertake to make it appear that this angle is not the moſt favourable to run with the greateſt velocity, in getting to windward. It ſhould be much more oblique; but as it is not poſſible, in practice, to attain the greateſt perfection, for very eſſential reaſons, ſuch as the ſolidity of the maſts, yards, &c &c, we muſt be contented to approach it as near as poſſible, in great ſhips, by reducing the angle A D R to 30 degrees only. This will be ſo much the more eaſily done, as in every ſhip the two foremoſt ſhrouds of each lower maſt can be ſuppreſſed. For it

muſt be obſerved that in the movement of pitching and rolling, the maſts always incline forward, in the direction D E of the effort of the ſail; ſo that the ſhrouds which are abaft, and cat-harpened in, are ſufficient to ſupport the maſts, ſince they act nearly oppoſite to the effort of the ſail. Beſides, ſhould there be reaſon to expect bad weather, preventer ſhrouds may eaſily be faſtened to the ſtrops which are always ready hung for that purpoſe. This practice is ſo much the better grounded, as the number of thoſe preventers can at any time be increaſed as circumſtances or neceſſity require*. Therefore, we ſhall, for the future, conſider the angle A D R, which is the moſt oblique in practice, as fixed at 30 degrees, though, in ſome ſhips, it may happen to be more acute: a circumſtance to which the manœuverer ought to pay a particular attention.

26. AMONG all the angles A D R, B D R, and H D R (*fig.* 9.) which the ſail A Z can make with the keel in the ſame courſe D R, it is evident there muſt be one more advantageous than the reſt, to give the ſhip the greateſt velocity poſſible in the moſt oblique courſe. Now, that angle of the ſail and the keel is not that we propoſe directly to determine, ſince it is impoſſible to render it more acute than 30 degrees, which is the term to which we have fixed it in practice: but it will ſerve us to determine the moſt favourable angle of incidence A D W of the wind upon the ſail, and which is the moſt advantageous to run with the greateſt rapidity on all oblique courſes between cloſe hauled and wind abaft.

27. BEFORE

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* But, ſhould this expedient be thought dangerous or troubleſome, the two foremoſt ſhrouds may be fixed with three ſheave blocks inſtead of dead eyes, according to the French faſhion. The two foremoſt ſhrouds to leeward being relaxed, would amazingly facilitate the bracing-up of the yard, which, as things are at preſent, is known to require a very great effort in our King's ſhips; and indeed it is not to be wondered at, ſince they are obliged to make a perfect elbow in two ropes of that ſize and tightneſs, before they can effect their purpoſe. Theſe ſhrouds, *in ſtays or before the wind*, would be eaſily ſet up equally taught with the reſt.

It is by no means neceſſary that Engliſh Rigg'd Ships ſhould have Blocks in their foremaſt Shrouds, tho' French Ships abſolutely require it — for this reaſon, our foremaſt dead Eye is always abaft of the Maſt — in French Ships their Shrouds extend further forward & of courſe muſt be relaxed when the Yard is to be braced up.

27. BEFORE entering upon the demonſtration of the rule which muſt be followed in practice, the principle which ſerves to demonſtrate its utility muſt be firſt eſtabliſhed.

IT may be recollected that impulſions (n. 7.) are between themſelves as the ſquares of the ſines of incidence. Therefore, to judge if it is advantageous to render the angle of incidence A D S or A D W of the wind upon the ſail A Z, more or leſs acute, we muſt examine if the ſquare of the ſine of incidence A F, or the total impulſion D E, increaſes more or leſs than the ſquares of the ſines of incidence B C, and H I, or than their correſpondent impulſions D G and D K, proportionally to the diminution or increaſe of the ſines of the angles of obliquity of the ſail with the keel A T, B Y, and H L: for, if the ſquare of the ſign of incidence H I, or the impulſion D K, does not increaſe ſo much proportionally, as the ſine of obliquity A T diminiſhes in becoming equal to L H, it is evident that the poſition of the ſail A D is more favourable than when it is ſituated in the direction D H: and if the ſquare of the ſine of incidence B C, or its correſpondent impulſe D G, diminiſhes more in proportion than the ſine A T augments, in becoming equal to the other ſign of obliquity B Y, in the other poſition of the ſail; it becomes an evident proof that its ſituation A D is ſtill more favourable than if it were in the poſition B D, and that there is no better ſituation than A D, whether the angle of incidence A D W be increaſed or diminiſhed.

28. To prove it, we ſhall conſider (*fig.* 9) the abſolute impulſions D K, D E, and D G, as being correſpondent with the ſines of incidence H I, A F, and B C, and proportional to the ſquares of theſe ſame ſines; then, on theſe diagonal lines, if we draw the rectangles X N and M O, in order to diſſolve thoſe total impulſions D E and D G, it will appear evident that the direct effort D X in the direction of the keel, is the greateſt poſſible, when the tangent A S of the angle of incidence is double the tangent A R of the angle

of

of obliquity of the ſail with the keel; for, if the angle of incidence be opened ten degrees, by placing the ſail in the ſituation H D, it will appear that, though the total impulſe D K is augmented in the ratio of the ſquare of the new ſine of incidence H I to the firſt A F, the partial effort D M, in the direction of the keel, will be nearly by one tenth leſs, in this ſituation of the ſail H D, than in the firſt A D. The direct impulſions D M, which proceed from the total ones D K and D G, are equal, becauſe theſe laſt have augmented or diminiſhed in the ſame ratio as the ſines H L and B Y have leſſened or increaſed in proportion to the ſquare of the ſine of incidence A F, and to the ſine of obliquity A T. Theſe direct partial-impulſions D M and D X are in a compounded ratio of the ſines of obliquity H L, A T, B Y, equal (n. 22.) to thoſe of the angles D K M, D E X, D G M, and of the total impulſions D K, D E, and D G; for, if the total impulſion augment by a movement of the ſail, the ſine of obliquity diminiſhes: ſo that from the total impulſions can at any time be deduced the direct ones for every poſſible angle of incidence. By calculation might very well again be verified this demonſtration, which proves that the tangent A s of the angle of incidence muſt always be double the tangent A R of the angle formed between the ſail and the keel, agreeably to the ſituation of the ſail A Z; ſince, if any other poſition be given to it with reſpect to the wind W, whether it be in the direction H D ten degrees more open than A Z, or like B D ten degrees more oblique, a reſult as D M, in the direction of the keel, will ever be found leſs than D X.—*Q. E. D.*

OBSERVATIONS.

As the vanes always indicate the apparent direction of the wind, on all the courſes the ſhip can ſail, the angle which the wind makes with the courſe, or the keel, cannot fail being eaſily known if

if there is no lee way; let that angle with the ſails be parted into two others, ſo that the angle of obliquity of the ſail with the courſe may have its tangent equal to half the tangent of the apparent angle of incidence of the wind upon the ſails. On this foundation, it will be eaſy to form a table which will always ſhow both the apparent angle of incidence, and that of the obliquity of the ſail with the keel, or with the courſe. This table will ſerve for all oblique courſes, whenever the after ſails ſhall not take the wind from thoſe forward, or will do it but in a trifling degree; for, ſhould they becalm them much, they muſt, for other conſiderations, be braced up a little more to the windward; but always have the precaution to leave the apparent angle of incidence of the wind upon the ſail more open than that between the ſail and the keel, or the courſe.

ARTICLE I.

Remarks on ſailing by the wind.

29. When it is neceſſary to gain to windward as much as poſſible, without abſolutely wiſhing to ſail with the greateſt velocity, let the direction of the coaſt under the lee be ſuppoſed to make with the abſolute direction of the wind (which muſt as near as poſſible be known) an angle of 90 degrees; or, in the ſea phraſe, *blowing dead on ſhore:* let the angle A C E (*fig.* 10.) formed by the ſail and the keel, be known to be 30 degrees, let the lee-way be alſo known to be 10 degrees, the angle E C I between the ſail and the courſe will conſequently be 40 degrees, which you muſt take from the total angle W C L 90 degrees; then there will remain 50 degrees, the half of which, 25 degrees, is to be taken for the abſolute angle of incidence W C E, and for its equal I C L; ſo that the ſhip A B will go 55 degrees from the wind when ſhe is cloſe hauled,

and

and will conſequently recede as much as poſſible from the point D on the coaſt, the direction of which makes an angle of 90 degrees with the abſolute direction of the wind W K.

But, if the ſituation C L, (*fig.* 11.) of the point D, from which you wiſh to move, made an obtuſe angle W C L, with the poſitive direction of the wind W M; then, the tangent of the apparent angle of incidence *w* C E, muſt be made double the angle of obliquity E C I, which the ſail makes with the courſe, at the ſame time that the angle I C L, of the courſe and the coaſt ſhall be made equal to the angle W C E, formed by the real direction of the wind W K, and of the ſail F E: ſo that two conſiderations muſt at once be attended to. For example: the angle A C E, formed by the ſail and the keel, is 30 degrees; then, according to the firſt principle, it will be neceſſary that the apparent angle of incidence *w* C E, ſhould be 49° 6′; and if the difference between the apparent and real direction of the wind be 10°, there will be 59° 6′ for the angle which the ſail E F, makes with the real direction of the wind W M: ſo that the angle L C I, of the courſe and the object ſtood from, muſt be found alſo to be 59° 6′, and the total angle L C W, will then be 148° 12′, adhering to the two principles of ſailing with the greateſt velocity, and of getting to windward of the point D, as much as poſſible, at the ſame time; while the angle L C *w*, formed by the apparent direction of the wind and that of the coaſt from which the ſhip moves, will be only 138° 12′. The yawing and the different velocities of the ſhip render the angle formed by the two directions of the wind, *viz.* the real and the apparent, more or leſs open. If the ſhip has more velocity at the ſame time, or if the courſe approaches more to the direction of the wind, it will appear by the vanes that the wind draws forward, and the angle of the two directions of the wind will augment. If the ſhip falls off, and yet ſtill preſerves the ſame velocity, or if her velocity decreaſes without altering her courſe, the wind will ſeem by the

vanes

vanes to draw aft, and the angle of the two directions will diminiſh; ſo that, whenever the ſhip ſhall have velocity or run obliquely to the wind, there will always be a difference between its real and its apparent direction. In ſhort, if the ſhip run exactly before the wind, or be in any ſituation having no motion, there will be then no other but the real direction of the wind ſhown by the vanes: but, let it happen how it will in oblique courſes, this is however certain, that the ſails are always ſtruck by the abſolute direction of the wind; becauſe, their poſition being once fixed by the braces and bowlines, it can no more change, but continues as ſteady as the real direction of the wind; for it is the vanes only which, being moveable, fix themſelves in a middle direction between the abſolute tendency of the wind and the courſe of the ſhip; whence we may eaſily conclude, as we did before, that the apparent direction of the wind ſhown by the vanes, is an intermediate one between the reſpective velocities of the ſhip and of the wind; ſince that direction neceſſarily partakes more of the greater velocity than of the leſs: ſo that, if the ſhip runs Eaſt, with the wind at South, having the fourth part of the velocity of the wind, the vanes will ſhow S. by E. 6° 45′ E. for the apparent direction of the wind.

ARTICLE II.

THEOREM OF MR. *BOUGUER.*

THE velocity and real direction of the wind is C M, (*fig.* 11): ſuppoſe the ſhip A B, of which E F is the ſail ſituated at pleaſure, to draw the courſe C I, while the particles forming the current of air run in the direction C M: if, from the point I, be drawn I K, parallel to the ſail E F, till it cuts the direction of the wind W K, in the point K, there will reſult the three points C, I, K, through

 which

which draw the circumference of a circle C I L K, and that circumference will ſhow the extent of the forces acting on the ſhip, at the ſame time, in following the courſe C I, provided her ſail be always trimmed in the ſame manner with reſpect to her keel.

DEMONSTRATION.

THE apparent or relative velocity of the wind is repreſented by I M (*fig.* 11.) in the courſe C I; and as I K is parallel to the ſaid E F, the angle M I K is equal to the apparent angle of incidence *w* C E. But to be more explicit: the wind ſtrikes the ſail with its apparent or reſpective velocity I M, (and not with its abſolute velocity, becauſe of the motion of the ſhip,) and with an angle of incidence M I K = *w* C E: ſo that, if the ſhip runs cloſe hauled or perpendicular to the direct wind W C, I M will become in both caſes ſtronger than the abſolute velocity; becauſe the ſhip will either approach to the ſource of the wind, or not recede from it. But the impulſe on the ſail is proportional to the ſquare of the velocity I M, multiplied by the ſquare of the ſine of the angle of incidence M I K, equal to the angle *w* C E (n. 3. & 7.); and the proportion M K: *ſine* K I M :: M I: *ſine* M K I, which furniſhes us the triangle K I M, ſhows us that M K × *ſine* M K I = M I × *ſine* K I M; ſquaring the two products, and ſubſtituting the ſine of the angle W K I in the room of the ſine of the angle M K I, which is equal to it, ſince they are the ſupplement of each other, we ſhall then have this other equality: *Sine* $\overline{\text{W K I}}^2 \times \overline{\text{M K}}^2 = \overline{\textit{ſine}\ \text{K I M}}^2 \times \overline{\text{M I}}^2$; whence it follows, that inſtead of expreſſing the actual impulſe of the wind upon the ſail by the ſquare of I M, multiplied by the ſquare of the ſine of the angle K I M, it may be expreſſed by the ſquare of M K, multiplied by the ſquare of the ſine of the angle W K I, or of its equal W C E, formed by the abſolute direction of the wind W M, and the ſail E F.

WE

We muſt not forget to pay a great attention to this obſervation; *viz.* that the impulſe of the wind upon the ſails is in equilibrium with the effort of the water on the prow, or that they are exactly equal and contrary when the ſhip is come to an uniformity of motion (n. 9.), as here we ſuppoſe her to be. Beſides, the impulſe of the water on the prow is proportional or equal to the ſquare of the velocity of ſailing C I (n. 3.); ſo that the ſquare of the velocity of ſailing C I, is equal to the actual compulſion of the wind upon the ſail expreſſed by the ſquare of K M, multiplied by the ſquare of the ſine of the angle W C E; and if s be ſuppoſed equal to the ſine of W C E, or of W K I, we ſhall always find $\overline{CI}^2 = s^2 \times \overline{KM}^2$. The firſt term in this equality repreſents the impulſe of the water on the prow, and the ſecond expreſſes the effort of the wind upon the ſails; and if the ſquare roots of the one and of the other be taken, it will be found C I = s × K M; that is to ſay, that the very velocity of ſailing C I, will be continually equal or proportional to the product of K M by the ſine s of the angle W C E or C K I. The proportion between theſe quantities depends on the denſity of the two fluids, and on the magnitude of the ſurfaces ſtruck: but it will be the ſame in all the different courſes.

The different velocities of ſailing C I, have a conſtant and given proportion with the products s × C K and C I × *ſine* C I K; for, the triangle C I K gives s : C I :: *ſine* C I K : C K, which forms this equality, s × C K = *ſine* C I K × C I; and all the angles C, I, K, are conſtant, and known, ſince they are equal, being alternate to that which the ſail makes with the courſe. But, as the velocity C I bears a continual and conſtant proportion with the product s × K M, and as it bears alſo a conſtant proportion with s × C K, it follows that s × K M : s × C K :: K M : K C; ſo that the point K always divides C M in the ſame proportion: the point K is then invariable when the ſail, as well as the lee-way, are both the ſame; (which never happens, however, as will be made appear (n. 47.) hereafter): but,

in admitting thoſe two hypotheſes, which never can deviate from the truth but in reſpect to the lee-way, which is always variable in the ſame ſhip, according to the different circumſtances of wind, ſea, velocity, ſail, and courſe, it ought then to be concluded that all the points, 1, &c, &c, will be ſituated on the circumference of a circle; for, without that, the angle C I K equal to thoſe which are formed by the ſail and the courſe, and which are ſupported on the ſame chord C K, would not be equal.

COROLLARY.

It follows (*fig.* 11.) from that the velocities are continually proportional to the ſines (whatever they be) of the angles W C E, which the ſail makes with the abſolute direction of the wind, provided the ſail be always trimmed in the ſame manner with reſpect to the keel, and that, in the triangle C I K, the ſide C K and the angle C I K are conſtant, and the velocities of ſailing C I are proportional to the ſine of the angle C K I equal to the angle of incidence W C E: it follows, I ſay, that all the other conditions being the ſame, the more the ſine of the angle W C E is augmented, the greater therefore will the rate of ſailing be; ſo that, if you want to carry it to the greateſt rapidity, you have only to make a right angle of the angle W C E formed by the abſolute or real direction of the wind with the ſail; then the velocity C I will no longer be a ſimple chord in the circle C K I, but a diameter. This holds good for all the ſhips which have but one ſail ſet; but, whenever they ſhall have ſeveral, the greateſt velocity will be when the apparent angle of incidence of the wind upon the ſail makes a right angle with the courſe; becauſe then the ſails will eaſily make with the apparent wind, an angle, of which the tangent will be double that of the angle they make with the courſe, without their becalming one another; while, at the ſame time, the ſhip will receive all the abſolute

lute impulſe of the wind, becauſe ſhe does not recede from it, and it is the time when the greateſt ſurface of ſail is expoſed to its action. The ſame advantage of the greateſt velocity will ſtill be had, when the apparent direction of the wind makes an angle of a hundred degrees with the courſe; and I am inclined to think that, in this ſituation, the velocity will in ſome degree be increaſed. In a word, whenever the after ſails do not becalm thoſe forward, the ſhip's rapidity may always be increaſed, by trimming the ſails as directed (n. 28.): but when the ſails take the wind from one another, an increaſe of velocity can no longer be pretended to.

Now, we are going to demonſtrate the exactneſs of the rule given before (n. 29.). When it is required to get off ſhore, or recede from a given right line with all poſſible expedition, or to keep abſolutely as cloſe to the wind as the ſhip will lie; C M (*fig.* 11.) is the abſolute direction of the wind; the circle C K L I marks all the points at which the ſhip can arrive with the ſame ſail, the ſame diſpoſition, without alteration of lee-way, and at the ſame time; and C L is the right line from which ſhe is to move. Knowing the angle that line makes with the abſolute direction of the wind W M, it is evident that the point I of the circumference, where the courſe ought to end, is in the middle of the arc C I L, of which C L is the chord: and all the points from one part to the other of C I, where the ſhip can come to at the ſame time, are leſs diſtant from C L, ſince D I, perpendicular to C L, divides it into two equal parts, and is the longeſt of all the perpendiculars which can be drawn from the circumference C I L; but the point I, cannot be taken without rendering the angle L C I equal to the angle C K I, which itſelf is equal to the angle W C E.

ARTICLE

ARTICLE III.

A TABLE of the ſituation of the ſails to run with the greateſt velocity.

Extracted from the MANOEUVRE OF SHIPS by Mr. BOUGUER.

Angles of the apparent direction of the wind and courſe.		*Angles of the ſails with the keel.*		*Angles of apparent incidence of the wind on the ſails.*	
D.	M.	D.	M.	D.	M.
180,	00	90,	00	90,	00
176,	15	87,	30	88,	45
174,	37	86,	25	88,	12
172,	30	85,	00	87,	30
168,	44	82,	30	86,	14
164,	58	80,	00	84,	58
161,	10	77,	30	83,	40
157,	22	75,	00	82,	20
153,	33	72,	30	81,	03
149,	41	70,	00	79,	41
145,	48	67,	30	78,	18
141,	53	65,	00	76,	53
137,	55	62,	30	75,	25
133,	54	60,	00	73,	54
129,	50	57,	30	72,	20
125,	42	55,	00	70,	42
121,	31	52,	30	66,	01
117,	14	50,	00	67,	14
112,	53	47,	30	65,	23
108,	26	45,	00	63,	26
a	- - - - - - - -	- - - - - - - -		- - - - - - - -	*b*
103,	53	42,	30	61,	23
99,	13	40,	00	59,	13
94,	25	37,	30	56,	55
89,	28	35,	00	54,	28
84,	23	32,	30	51,	53
79,	06	30,	00	49,	06
73,	39	27,	30	46,	09
68,	00	25,	00	43,	00

N. B.

N. B. The foregoing TABLE can be of no great ſervice, except in the eight laſt circumſtances under the line *a*, *b*; becauſe, in all the caſes mentioned above that line, the ſails will cover one another too much.

OBSERVATIONS.

WHEN a fine-ſailing ſhip (ſuch as will, on a direct courſe, or right before it, take a third or a fourth part of the velocity of the wind) comes to run with the ſame quantity, or more ſail, on a perpendicular to the apparent direction of the wind, then ſhe acquires a greater rapidity of ſailing with reſpect to the velocity of the wind; the angle formed by the two directions, the apparent and the abſolute, is at that time very conſiderable; it may be from 18° to 22° 30′; and if the ſhip hauls quite cloſe by the wind, the angle will ſtill be nearly the ſame; for, her velocity diminiſhes: but, as it is in ſailing by the wind that it is moſt eſſential to know the greatneſs of the angle between the two directions of the wind, let the angle between the directions of the ſhip's head on the different tacks be obſerved, without paying any regard to the lee-way, but juſt to the exact point on which the ſhip ſtands, before and after going about, when ſtrictly by the wind, neither too much to leeward nor to windward; and when you have determined that angle, from two or three obſervations, halve it, and then you will have the angle formed by the keel and the abſolute direction of the wind; by which you will know the quantity ſhe will come to upon the different tacks, and will never be deceived with reſpect to the lying on after having gone about: a miſtake pretty commonly made by thoſe who pay attention only to the apparent direction of the wind, which always makes with the real one an angle more or leſs open in a compound ratio of the greateſt velocity with the greateſt obliquity of the courſe of the ſhip, with reſpect to the direction

direction and the abſolute velocity of the wind; things which vary in all ſhips, becauſe they have not all the advantage of ſailing with the ſame rapidity in ſimilar circumſtances.

CHAPTER IV.

Of the maſts and ſails which are before the center of gravity of a ſhip.

30. THE ſails which are before the center of gravity of a ſhip, are the ſprit-ſail, bowſprit top-ſail, the jib, the fore-top-maſt ſtay-ſail, and the fore ſtay-ſail.

ALL theſe ſails belong to the bowſprit, which projects out of the ſhip, over the ſtem, obliquely to the horizon. The fore ſtay-ſail hoiſts on the fore-maſt, which is ſtepped on the extremity of the keel; and the jib, and the fore-top-maſt ſtay-ſail, are hoiſted on the fore-top-maſt, which is raiſed above the laſt-mentioned maſt. Theſe maſts carry alſo a ſail more conſiderable than the former. The fore-maſt carries the ſail which bears its name, bent to its yard. There is a boomkin on each bow, placed perpendicularly under the extremity of the yard, when by the wind, for the purpoſe of extending the foot of this ſail: the ſheets are hauled aft to the ſides of the ſhip. Directly over this laſt ſail is placed another, called the fore top-ſail, which is carried by its own yard, and tallied on the fore yard: it is hoiſted, when wanted to be ſet, on the ~~little~~ top-maſt. Now, this very fore top-ſail is itſelf again ſurmounted by the top-gallant, carried by its own yard and maſt, and tallied on the fore-top-yard, as the ſail of this is on the fore yard.

yard. There is ſtill over all this ſometimes another ſail, called the top-gallant royal-ſail, or only the royal-ſail: ſo that the three laſt-mentioned ſails, *viz.* the fore-ſail, the fore top-ſail, and fore top-gallant-ſail, may be looked upon as making only one large ſail, wide at the foot and tapering towards the head, and which can be reduced, as occaſion requires, either by taking in the royal, which is the higheſt, or by reefing the fore top-ſail, or even taking it quite in, if neceſſary, to have the fore-ſail only ſet; or by hauling the fore-ſail up, if nothing but the top-ſail is wanted. It muſt notwithſtanding be obſerved alſo, that the different parts of the whole ſail may, in certain caſes, be manœuvered differently the one from the other; as, for example, in reefing the top-ſail, or in taking in either the one or the other. But, when you want to ſet them to work all together, either for making a courſe, or performing ſome evolution, they muſt all be braced and trimmed in the ſame form, and with the greateſt uniformity poſſible. Therefore, whatever we ſhall ſay concerning one of them in any manœuvre, is to be underſtood to be the ſame with reſpect to all the reſt.

We wiſh not, however, to neglect obſerving here, alſo, that the ſails compriſed under the general French denomination of *Focs*, *viz.* the jib, ſtanding jib, fore-top-ſtay-ſail, and fore ſtay-ſail, as well as thoſe compriſed under that of *Civadières*, which are the ſprit-ſail and bowſprit top-ſail, are no-ways connected with each other, any more than are likewiſe the main ſtay-ſail, the main-top-ſtay-ſail, the preventer ſtay-ſail, or the main top-gallant ſtay-ſail, which are likewiſe ſails of the fore part of the ſhip's center of gravity, and the haliards of which are fixed at the head of the main maſt, the main-top-maſt, and the main-top-gallant maſt, while their tacks are at the foot of the fore-maſt, in the fore-futtocks, in the ~~main~~ fore-top-ſhrouds, and on the top-gallant futtocks, under the croſs-trees.

ARTICLE I.

Of the effect of the Lateen ſails, which are on the fore part of the center of gravity of a ſhip.

31. The jib and ſtay-ſails being of a triangular or trapezoid figure, their center of gravity is eaſily found; and that point is to be conſidered as the part, in all theſe ſails, on which the whole effort of the wind is united, when they are expoſed to its impulſe, whatever be the way in which it ſtrikes them.

The effort of each Lateen ſail ſingly being on the fore part of the center of gravity of the ſhip, it follows that the total effort of all theſe ſails muſt be there too; and that if the ſhip was in a perfect equilibrium with reſpect to the wind, before her ſails were ſet, ſhe will loſe it immediately after (n. 11.); they will always make the fore part of the ſhip obey the wind whenever it ſtrikes them perpendicularly or obliquely. For, it muſt be obſerved, that almoſt all theſe ſails have their tacks in the middle of the ſhip, and are tallied on the ſide of her; ſo that they make with the keel a very acute angle: whence it is eaſy to conceive, that a perpendicular raiſed on the exterior ſurface of theſe ſails, in the direction of their effort to leeward, from their center of gravity, would differ but very little in the lateral direction from a perpendicular to the keel. From this we may therefore conclude, that theſe ſails would have but very little effect to accelerate the rapidity of ſailing with reſpect to their poſition, if it was not demonſtrated that they are very advantageous in going by the wind. Beſides, they make alſo the ſhip ſteer well, and are particularly uſeful when a ſhip gripes or requires a great deal of weather helm: and, when they do not take the wind out of any of the ſtanding or lower ſails, they ought to be uſed, particularly when one is obliged to ſail by the wind, or to run

run not very large. The jib and fore-top-maſt ſtay-ſail muſt be preferred, becauſe they are at all times uſeful when they are not hindered from receiving the wind in them: for, their poſition is ſuch, that they cannot take the wind out of any of the other ſails, and their particular effect in wearing is very conſiderable, not only on account of their great ſurface, but becauſe they act before the point, on which the ſhip turns, with a very long arm of a lever (n. 17.). On the other hand, all the ſails draw the ſhip a-head in raiſing her: for, the direction of their effort aſcends obliquely towards the horizon; therefore, (a very great advantage, which is peculiar to them) they do not make her dive in the water. Experience has, many a time, confirmed me of their utility on all occaſions when they could be employed without taking the wind out of the other ſails.

ARTICLE II.

Of the effect of the fore-ſail, fore top-ſail, fore top-gallant-ſail, and ſprit-ſail, in their different ſituations.

32. When the ſail A B (*fig.* 12.) is trimmed cloſe to the wind which blows from the point W, it is impelled in the direction C D (n. 7.) with a force expreſſed by the ſquare of the ſine of incidence, and compoſed of the two effects C E and E D (n. 19.) But, as the center of effort of that ſail A B is on the fore part of the center of gravity of the ſhip H, and as its power C D is always diſcompoſed between thoſe two effects C E and E D, it follows, that the effect of this ſail is to cauſe the ſhip to bear away; while it keeps up at the ſame time, and even augments, the rapidity of ſailing.

33. If the fore-ſail A B received the impulſe of the wind perpendicularly, it would ſtill produce the ſame effects, *viz.* bearing away, and augmenting the rate of ſailing, for the ſame reaſons juſt

given above, but more effectually (n. 29.), on account of the increaſe of the impulſe of the wind upon the ſail.

COROLLARY.

34. It follows, from what has been ſaid, that when the ſails upon the fore-maſt are full, on the ſame ſide they are tacked, and braced obliquely to the keel, there is always one part of their effort, in proportion to their obliquity, which acts to make the ſhip bear away; while the other part of their effort acts at the ſame time to accelerate or keep up the rate of her ſailing.

35. When the ſails A B of the fore-maſt (*fig.* 13.) are ſituated obliquely with reſpect to the keel, and receive the wind in them, on the ſide of the ſheet B, they act upon the ſhip in bringing her then to windward, becauſe their effort D G being diſcompoſed, as cuſtomary, the lateral part D F carries the fore part of the ſhip towards the ſource of the wind W, in carrying her from D to F.

REMARKS.

36. In general, when the yards are ſquare or perpendicular to the keel, it is evident they will act on the ſhip, only by impelling her right in the direction of the keel, from ſtern to head, or from head to ſtern, with more or leſs velocity, in proportion to the impulſe of the fluid which ſtrikes them.

37. When the ſails A B on the fore-maſt (*fig.* 14.) receive the impulſe of the wind W, on their anterior ſurfaces, they will make the ſhip both go a-ſtern and fall off; becauſe the direction C E of their effort, being turned towards the after-part of the veſſel, ſerves as a diagonal to the parallelogram F D, which, by diſcompoſing it, will ſhow us thoſe two effects C F and C D, the firſt of which takes its direction with that of the keel from forward aft; while the ſecond takes it in a lateral direction in making the ſhip to turn.

REMARKS.

38. When the wind blows between the keel and the yard, the ſhip comes to until the point G (*fig.* 14.) is in the direction of the wind W. But, as ſoon as this is executed, it is evident ſhe falls off; for, the point G recedes farther and farther from the direction of the wind. Whence we are naturally led to make this remark as we go; *viz.* As ſoon as the weather part of the ſail catches a-back, on the tack ſide, the angle of incidence of the wind on it goes continually increaſing, till the ſhip has fallen off ſo much, that her ſail becomes perpendicular to its direction: and if the veſſel continues to fall off, then the angle of incidence diminiſhes more and more, till the ſail is parallel to the courſe of the wind which comes from the tack B, or, in the marine phraſe, *ſhivering*.

CHAPTER V.

Of the maſts and ſails abaft the center of gravity of a ſhip.

39. The main-maſt and all its ſails are placed abaft the center of gravity of a ſhip, which is alſo abaft the point round which the total effort of the ſails is placed. They are fitted and manœuvered in the ſame manner as the ſails on the fore-maſt. There is, beſides, the mizen-maſt, which, when placed more aft, is highly uſeful in certain evolutions to accelerate, by its ſails, the movements of rotation which one wiſhes the ſhip to execute. Between this laſt and the main-maſt are placed the mizen ſtay-ſail, and the mizen-top Mast ſtay-ſail, to fill up the vacancy the other ſails leave between them.

ARTICLE

ARTICLE I.

Of the effect of the Lateen ſails abaft the center of gravity of a ſhip.

40. The center of effort of theſe ſails being abaft the center of gravity of the ſhip, it follows they always force the after-part of the ſhip to leeward, and conſequently contribute to bring her to the wind, as ſoon as they receive its impulſe; for, that movement of the after-part of the ſhip cannot happen, without the head approaching to the direction of the wind.

OBSERVATIONS.

On the Lateen ſails.

The Lateen ſails being in general ſituated very obliquely, it follows, if we reaſon conformably to principles, that they are very advantageouſly ſo for ſailing by the wind. Therefore, we muſt not neglect augmenting them: obſerving, at the ſame time, that they do not take the wind out of one another, nor becalm the principal ſails. They are only to fill up the ſpace between the maſts fore and aft, in ſailing on a bowline, in order that no wind may be loſt.

ARTICLE II.

Of the effect of the ſails of the main-maſt, and of the mizen top-ſail, in their different obliquities.

41. As we have already demonſtrated (n. 19.) that when the ſail A B (*fig.* 15.) is trimmed obliquely to the keel, it produces evidently two effects on the ſhip; we draw here this conſequence; *viz.* that in diſſolving its power C D, we ſhall find its compound effects,

effects, the one C F, in the direction of the keel which produces the velocity, and the other C E lateral, which (in forcing the after-part of the ſhip to leeward, by its action on the point C abaft the center of gravity G of the ſhip) induces her to come to the wind; for, that motion of the ſtern from C to E, cannot take place without the fore-part H acting in oppoſition by the very act of coming to the ſource of the wind W.

REMARKS.

42. If the ſails A B (*fig.* 15.) were more or leſs oblique to the keel, they would produce ſtill the ſame effects of keeping up the ſhip's velocity, and bringing her to the wind. And if they received its impulſe perpendicularly, it would ſtill be the ſame thing; with this difference, however, they would produce thoſe two effects with greater efficacy than in any other ſituation with reſpect to the wind, becauſe then they receive its greateſt poſſible impulſe for the time.

43. When the ſails A B (*fig.* 16.), of which the center of effort C is abaft the center of gravity of the ſhip, receive the impulſe of the wind W on the ſheet ſide, and obliquely placed to the keel*, they will cauſe the ſhip to fall off, by forcing the after-part of the ſhip from C to F, towards W, the ſource of the wind, while they will, at the ſame time, keep up the velocity C I. For, this motion of the after-part E towards W, cannot be executed without the fore-part H going, as it moves off, in a contrary direction; and ſhe will continue to fall off till the keel E H be right in the direction of the wind W C, or right aft; then the ſhip will come to the wind, as ſhown in the two preceding articles.

It

* Let it be well underſtood, that it is with her yards braced to port; or, to be more explicit, when a ſhip has her larboard braces hauled in aft, and the wind at the ſame time on the ſame quarter.

It may be remarked that, in this movement of the ſhip, the angle of incidence goes continually increaſing till the wind is perpendicular to the ſails.

44. When the ſails A B (*fig.* 17), of which the center of effort is abaft the center of gravity G, ſhall receive the impulſe of the wind W on their interior ſurfaces, they will make the ſhip come to the wind, and go a-ſtern at the ſame time. For, the direction of their effort C D may be diſſolved between the two efforts C F, in the direction of the keel, from forward to aft, and C E lateral and perpendicular to the keel; ſo that the after-part C H is forced to leeward from C to E, while the fore-part I approaches, by a contrary motion, the ſource of the wind W. In this caſe, conſequently, the ſhip comes to, and goes a-ſtern, at the ſame time.

REMARKS.

45. When a ſhip is ſo far come to the wind, that the fore-part I (*fig.* 17.) is poſitively in its direction, it is evident that ſhe will fall off more and more; for, the point I will be conſtantly moving from the ſource of the wind W C; therefore, it is demonſtrated that, in this caſe of evolution, the ſine of incidence is continually decreaſing more and more, till it is reduced to nothing. But, if the direction of the wind had made an obtuſe angle W C B, the ſine of incidence would have augmented until the direction of the wind had been perpendicular to the ſails; and it is at that moment only it would have begun to diminiſh, as ſhown above.

CHAPTER

CHAPTER VI.

Of the equilibrium neceſſary to be maintained in practice, between the ſails before and abaft the center of gravity of a ſhip, in order that the ſailing may be the moſt direct and the moſt rapid poſſible.

46. AFTER having demonſtrated the different effects of the ſails on the part of the ſhip before and abaft the center of gravity, it is plain that, if the head, or after ſails, only were ſet, in ſailing by the wind, the ſhip would not only ſteer badly, but conſequently ſail not ſo faſt, as ſhe could under the ſame quantity of ſurface, *if an equilibrium was kept up fore and aft in the diſpoſition of the ſails.* For, if the ſhip be ſuppoſed (*fig.* 18.) to be under her head ſails, and one half be retrenched and ſet on the maſts abaft, it will evidently appear that the velocity C T they produced is the ſame, ſince the direction and the velocity of the wind act always in the ſame manner on the ſame quantity of ſurfaces; the only difference which will be found, is, that the primitive effect is divided, and acts now on the points C, C, C, before and abaft the center of gravity of the ſhip. But, it is not the ſame with reſpect to the effect C D, which acted to pay the veſſel's head round, in the firſt diſpoſition of the ſails, becauſe that effect being now divided on the after-maſts, it is diminiſhed one half C E forward, by the very act of its tranſporting itſelf with the ſame force aft, where, balancing the effect of falling off produced by the head-ſails, it keeps, by an equality in the movements, the ſhip to the wind (nn. 34 & 42). I ſay it balances, becauſe it is always in the power of the officer, when the

weather permits, and whenever he chooſes, to increaſe or diminiſh the head or after ſails, ſo as to maintain an equilibrium between their powers, and fix the ſhip on her courſe. No ſooner is this point of equilibrium obtained, but one is ſure to have got the moſt advantageous diſpoſition the ſails can have for the veſſel to run with the greateſt celerity; provided alſo they have been trimmed in the moſt favourable manner to receive (n. 28.) the greateſt impulſe of the wind.

This equilibrium between the powers of the ſails forward and aft, is again infinitely advantageous with reſpect to the rudder; becauſe, as there is leſs occaſion to uſe it to regulate the movements of the ſhip, its ſurface oppoſes itſelf but little, as well as not ſo often, to the ſhock of the fluid, which glides along the ſhip's bottom. It is then of the greateſt importance, when the ſhip ſails with rapidity, to combine, as much as poſſible, in trying various ways, the reciprocal effect of the ſails fore and aft; as for example, in ſetting to the wind, or in diſpoſing more advantageouſly on the head or ſtern, a greater or leſs quantity of ſails, according as the ſhip is more or leſs inclined to fall off, or come to; in order to be able to make as little uſe of the helm as poſſible; although, at the time of performing any evolution, its full power muſt be put in action; as we ſhall have occaſion to make it appear hereafter.

OBSERVATIONS.

47. When there is an equilibrium between the ſails fore and aft, the reſiſtance of the water from A to B (*fig.* 18.) on the prow is equal to the power of the ſails, whether it paſſes through the center of gravity H of the ſhip, or through another point of the axis, more or leſs forward or aft; then a ſhip, thus ſituated, finds no more difficulty to wear than to come to the wind, with reſpect to the reſiſtance of the water under her lee; ſince all things are equal,

equal, *viz.* the reſiſtance of the water upon the bottom to leeward, and the impulſe of the wind upon the ſails. But it muſt be conſidered that the power compoſed of thoſe of all the ſails united, acts upon the ſhip according to the direction B A, perpendicular to their ſurfaces, the origin of which is the point H, a middle between all the effects C G of the ſails placed fore and aft, which ought to correſpond exactly with the reſiſtance of the fluid from A to B: ſo that the ſhip is puſhed to leeward of the courſe I K, which ſhe holds into the direction B A of the effort of her ſails; but the reſiſtance ſhe finds from the water on the lee-ſide of her bottom, from A to B, ſets her to rights again by its oppoſition, which is greater in ratio of the greater facility ſhe finds in dividing the fluid with her ſtem, than with her ſide; ſo that ſhe runs on the true courſe N R, which approaches nearer that on which the ſhip is made to ſteer, than B A. From this may be ſeen, that the angle K H R of the lee-way is proportional to the greater or leſs reſiſtance the ſhip finds laterally from the fluid under her lee; a reſiſtance which depends intirely on the more or leſs facility ſhe finds in dividing the water with her prow; ſo that the lee-way can never be conſiderable but when cloſe hauled; a reaſon why it is not much taken notice of when the courſe is leſs oblique than the wind on the beam. This reaſoning might be carried ſtill further, from a fact undeniable in the practice by thoſe who have had any experience, and which proves that the lee-way depends, not only on the form of veſſels, but ſtill more on their greater or leſs velocity, and ſeldom, or never, on the intire diſpoſition of their ſails more or leſs oblique to the keel, as ſome authors have advanced. For, when a fine-ſailing veſſel is trimmed ſharp, with all her ſails ſet, in a very light breeze, with which ſhe hardly ſteers, the lee-way is conſiderable, though the ſea be perfectly ſmooth. The reaſon of this great lee-way, made by the ſhip, is that the veſſel being impelled gently only, and with little force, the water, which is not ſhocked with vio-

lence, does not reſiſt her, and ſhe is then carried eaſily by her ſails in the direction of their effort B A: and if we conſider the ſide of the ſhip, on the act of ſailing, preſenting a very great ſurface of ſails above the water, it will viſibly appear the lee-way will become ſtill more perpendicular to the keel. But, ſhould the wind begin to freſhen pretty much, then the rapidity of ſailing augments conſiderably, and the ſhip ſhocks the fluid with a force expreſſed by the ſquare of ſix or nine knots of velocity from B to A (*fig.* 18.) in the ſpace of an hour, while the water repels her effort in a contrary direction: the reſiſtance of the water is then in the ratio of this ſquare to the ſquare of her firſt velocity, and the fluid now no longer yields with facility (n. 4.); the lee-way is ſuddenly diminiſhed, and is reduced to five or ſix degrees, and ſometimes leſs, if the rapidity of ſailing continues to increaſe; if, at the very time when the ſhip has acquired already a very great velocity, ſhe be kept away 12° or 15°, or even 22° 30′, without altering the ſails, their obliquity remaining the ſame, the ſhip ſhould then fall off in the ſame proportion, according to the opinion of thoſe who have written on the theory of the manœuvre of ſhips. Notwithſtanding it is what never happens; the velocity augments, becauſe the ſails then receive the wind with a greater fine of incidence, and thereby acquire more power, while the prow continues to be ſtill ſhocked by the fluid in the ſame parts, and with the ſame fine of incidence; ſo that the lee-way diminiſhes again, becauſe, from the increaſe of velocity, the water makes a greater reſiſtance, and that reſiſtance is greater on the ſhip's ſide than on her prow, which is leſs expoſed to the ſhock. Whence muſt be concluded that the lee-way, in the ſame ſhip, does not depend alone on the diſpoſition of her ſails, and that in various ſhips it always differs, from their not having the ſame form, or their ſails not trimming equally in the ſame oblique courſes; and becauſe, in fine, none have the ſame velocities with the ſame weather, and under the ſame ſails. Which

proves,

proves, in a word, that the lee-way is always in a proportion compounded of the velocity of the ſhip; of her form, which gives her more or leſs reſiſtance on her ſide than on the prow; and of her ſails, trimmed more or leſs obliquely.

To return to the conſideration of the action of the water on the bottom from A to B (*fig.* 18.), it muſt be remarked, that it acts afore, and that it muſt conſequently contribute very much to the facility which almoſt all ſhips have in coming to the wind, whenever the after-ſails are in the ſmalleſt degree more powerful than thoſe forward: for, in that caſe the ſhock of the water is a power which is to be added to that of the impulſe of the after-ſails, ſince this action of the fluid is ſo much the ſtronger as it acts before the center of gravity of the ſhip at the point M (*fig.* 18.), in impelling the fore part towards the wind, which always makes ſhips difficult to wear, becauſe all the effort A B of the water's reſiſtance upon the prow is oppoſed to this movement, in forcing this part to windward with a very great effort.

It is not therefore to be wondered at when ſhips wear with difficulty or ſlowly, eſpecially ſuch as have what is called a rank cut-water or long prow; becauſe there are two forces acting one againſt the other, and that the force which comes from the ſail muſt ſurmount (n. 18.) that which comes from the water, before ſhe can fall off: which will always happen with facility, whenever, in ſuppreſſing ſome of the after-ſails, thoſe forwards ſhall be diſpoſed favourably enough to produce that effect; and in uſing alſo the rudder at the ſame time, whoſe power is great, whether the ſhip goes a-head or a-ſtern rapidly.

But if the ſhip, being abandoned to her own proper movements in an oblique courſe, had on a ſudden all her ſails ſuppreſſed, it is certain the veſſel would come to the wind, ſhould even the rudder never be uſed; becauſe the water, acting on the fore part of her bottom more on one ſide than the other, impels the head to windward

ward againſt the ſmaller reſiſtance, until its power is entirely deſtroyed by the total ceſſation of the ſhip's velocity.

OBSERVATIONS.

When the ſhip runs ſo large that the after-ſails becalm part of thoſe forward, this is again another reaſon for the ſhip carrying a weather-helm, or having an inclination to come to the wind; for, the ſails forward receive a much leſs impulſe from the wind than in a courſe more oblique; becauſe the ſails abaft, by increaſing in their power, prevent thoſe forward from having as much wind as their ſurfaces require, ſince all the lee parts of theſe ſails become uſeleſs for the moment, being becalmed by the weather part of thoſe on the main maſt; ſo that the power of the ſails forward diminiſhes, while that of the after-maſts increaſes; for, the fine of incidence is greater. The ſhip ought then, for theſe reaſons, to have more inclination to come to the wind; but, regard muſt be paid to the direction of the power of the ſails in general, which now becomes nearer the direction of the keel: ſo that the greateſt part of their effort is in that direction, while their force in the lateral one diminiſhes.

It is farther to be obſerved, that when the ſhip has as much ſail as the weather will permit her to carry, that is the moment of the greateſt velocity of ſailing, providing that the ſails having at the ſame time received the moſt favourable diſpoſition, an exact equilibrium has alſo been placed between them afore and thoſe aft, ſo that there ſhould be little occaſion for the uſe of the rudder.

APPLICATION.

48. From what precedes may be deduced the method of diſtinguiſhing the degree of quickneſs and celerity with which different manœuvres

manœuvres ought to be performed. For example, when one is obliged to run for a road-ſtead, and to let go an anchor as ſoon as come to it, it is evident this manœuvre ought to be executed but under little ſail, which ſhould be all on the part before the center of gravity; becauſe, in the firſt place, a ſhip has always velocity enough when ſhe ſails large; ſecondly, becauſe ſhe is to overcome the effort A B (*fig.* 18.) of the water which oppoſes her movement. On the contrary, when obliged to come to the wind in anchoring, as many ſails as can conveniently be managed at that moment may be ſet, becauſe that movement of the ſhip is always very quick, and that as ſoon as the ſails take a-back, the rapidity of the ſteering diminiſhes, and in a few moments entirely ceaſes, whereas it always augments when the ſhip falls off.

ARTICLE I.

Remarks on the effect of the main-ſail.

49. In the uſe of the ſails, attention ſhould be paid to the effect of the main-ſail, which perhaps may not be that of bringing the ſhip to the wind; for, if the ſhip be too much loaded a-ſtern, the center of gravity H (*fig.* 18.) of the ſhip might very well in that caſe be abaft the main-maſt, and then the direction of the effort of that ſail, quitting the point C before the center of gravity, ought to make the ſhip fall off in lieu of keeping it up to the wind. But, that this ſhould happen, the ſhip muſt be either very ill conſtructed, or very badly loaded; or, in ſhort, there muſt have been originally a very groſs error in the firſt fixing of her maſts.

Notwithstanding the main-ſail can always, at the pleaſure of the manœuverer, be made to aſſiſt the ſhip in wearing, though the center of gravity H be (as it almoſt ever is) before the effort C of the main-ſail. To do it, the effect of that ſail need only be changed,

changed, by making it to paſs before the center of gravity of the ſhip: which will be ſuddenly the caſe, if, when cloſe hauled, the main ſheet be let go a-main, becauſe the weather part of the ſail being fixed forward by the tack, its effect is likewiſe before the center of gravity of the ſhip, though it has loſt in that part a great deal of its power, in becoming leſs expoſed to the impulſe of the wind; while the lee part, bellying out more, may receive a great impulſion of the wind, which will ſtrike it more and more perpendicularly as the ſhip ſhall fall off with more and more rapidity. In this caſe, it may happen, that if the direction of the effort C G of the main-ſail do not paſs before the center of gravity H of the ſhip, it comes ſo near that point, that it may be ſaid to have no longer the effect of an after-ſail.

ARTICLE II.

Of the rudder.

50. THE rudder is a machine known to all the marine world; it is ſupported by the ſtern-poſt, and turns on hinges thereto affixed. It acts by means of a lever, called a tiller, which enters horizontally into the ſhip, in paſſing over the tranſom; ſo that if, inſtead of leaving the rudder exactly in a right line with the keel A B, and as it were a prolongation of it, it be turned to one ſide or the other, as B D (*fig.* 19.), it receives an immediate ſhock from the water which glides along the ſhip's bottom, in running aft from A to B; and this fluid impels it towards the oppoſite ſide, while it continues in that ſituation, ſo that the ſtern, to which the rudder is confined, receives the ſame movement; and, the ſhip receiving a ſidely impulſion, her aft turns accordingly from B to *b*, on any point whatever C (n. 18.), while her head paſſes from A to *a*. It muſt be obſerved, that the water ſtrikes the rudder obliquely, and only

only with ſuch part of its motion which acts according to the ſine of incidence, in impelling it in the direction N P with a force which depends not only on the rapidity of ſailing, but alſo on the greatneſs of the angle of incidence: a force which is conſequently in the compound ratio of the ſquare of the more or leſs velocity with which the ſhip advances, and of the ſquare of the larger or ſmaller ſine of incidence which neceſſarily increaſes or diminiſhes according to the various circumſtances. So that, if the veſſel runs three or four times more ſwiftly, the abſolute ſhock of the water upon the rudder will be nine or ſixteen times ſtronger under the ſame angle of incidence, and will be augmented in a greater proportion, if the ſine of incidence be increaſed. This impulſion, or, what is the ſame, the power of the helm, is always very feeble, when it comes to be compared with the whole weight of the veſſel; but it operates with a very long arm of a lever: whence it reſults that its efforts to turn the ſhip are extremely advantageous; for, the helm is fixed at a very great diſtance from the center of gravity G, as well as from the point C, upon which the ſhip is ſuppoſed to turn horizontally, with reſpect to the point of percuſſion B: and if the direction P N of the impreſſion of the water upon the rudder be prolonged, it is evident it will paſs perpendicularly at the point R, widely diſtant from the center of gravity G; therefore the abſolute effort of the water is very powerful. It is not therefore ſurpriſing, if this machine impreſſes the ſhip with a conſiderable circular movement, by impelling the ſtern from B to *b*, and the head from A to *a*, and even much farther, when the velocity of the ſhip is kept up; becauſe the effect of the helm always keeps pace with the rapidity with which the veſſel advances.

51. Amongst the ſeveral obliquities which may be given to the rudder, there is one ſituation which is more favourable than any of the others to make it produce with more rapidity the deſired effect of turning the ſhip, in order to change her courſe. To be

convinced of this, we have but to conſider that, if the obtuſe angle A B D (*fig.* 19.) were to be leſſened, the impulſe of the water on the rudder would augment, at the ſame time that it would offer a greater reſiſtance to the ſailing of the ſhip, ſince the angle of incidence would be more open, and preſent a greater ſurface (n. 7.) to the ſhock of the water by oppoſing its paſſage more perpendicularly. But, then the direction N P of the effort of the helm upon the ſhip would paſs at a ſmaller diſtance from the center of gravity G towards R, and leſs approach the perpendicular N L, according to which it is abſolutely neceſſary that the power applied ſhould act with greater effect to turn the ſhip. Therefore, it is evident that, if the obtuſe angle A B D were too much cloſed, the greater ſhock of the water could not counterbalance the loſs ſuſtained by the diſtance between the direction N P and that N L, or by the great obliquity which would be given to the ſame direction N P of the abſolute effort of the helm with the keel A B.

If, on the other hand, the angle A B D were too much opened, the direction N P of the effort of the rudder would become more advantageous to turn the ſhip, ſince it would approach more the perpendicular N L, and ſince the prolongation of N P would augment G R, by paſſing at a greater diſtance from the center of gravity G. But, then, the rudder would receive the impulſion of the water too obliquely; for, the angle of incidence would be more acute: ſo that it would only preſent a ſmall proportion of its breadth to the ſhock of the water, and of courſe receive alſo but a very faint impulſion. All which proves that the greateſt diſtance G R from the center of gravity G, is likewiſe inſufficient to repair the diminution of force occaſioned by the too great obliquity of the ſhock of the water. Whence it muſt be concluded, that when the fluid ſtrikes the rudder too obliquely, or too perpendicularly, a great deal of the impulſion, or of the effect it ſhould produce, is loſt. Therefore, between theſe two extremes, there muſt be a middle

middle poſition, which certainly is the moſt favourable to its operations.

52. The diagonal N P of the rectangle I L (*fig.* 19.) repreſents the abſolute direction of the effort of the water upon the rudder: N I expreſſes the portion of this effort which oppoſes the ſhip's head-way by forcing her a-ſtern in the direction of the keel. It is eaſy to perceive that this part N I of the whole power of the helm contributes little to turn the veſſel; for, ſhould you prolong I N, you might ſoon ſee that its direction paſſes at a very ſmall diſtance G W from the center of gravity G, and that the arm of the lever B N = G W, to which the force is as it were affixed, is at moſt equal only to one half of the breadth of the rudder. But, it is far from being ſo with reſpect to the relative force N L, which acts perpendicular to the keel. If the firſt force N I is almoſt uſeleſs, and even pernicious, by retarding the velocity; the ſecond N L is capable of a very great effect, ſince it is applied at a conſiderable diſtance from the center of gravity G of the ſhip, and acts on a lever's arm G E, which is very long, and neceſſarily very powerful. Thus, it appears clearly, that between the two effects N L and N I, which reſult from the abſolute effort N P, there is one which is always oppoſing a reſiſtance to the ſhip's rapid head-way, and contributes very little therefore to the motion of her turning; whilſt the other alone produces that movement of evolution, without operating any way to retard her velocity.

53. Geometricians have determined the moſt advantageous angle made by the helm with the line prolonged from the keel, and fixed it at 54° 44′, on a preſumption that the ſhip is not wider at her floating line, or at the line deſcribed by the ſurface of the water round her bottom, than at her keel. But, as this ſuppoſition is abſolutely falſe, inaſmuch as all veſſels augment their breadth from the keel upwards to the extreme breadth where the floating line, or higheſt water-line, is terminated; it follows that this angle

is too large by a certain number of degrees. For, the rudder is ſhocked by the water at the height of the floating line more perpendicularly than at the keel, ſince the fluid exactly follows the horizontal outlines of the bottom: ſo that one could almoſt ſay that a particular poſition of the helm might be required for each different ſine of incidence which it encounters from the keel upwards. But, as a middle poſition may be taken between all thoſe points, it is quite ſufficient to conſider the angle formed by the ſides of the ſhip and her axis, or the middle line of her length at the ſurface of the water, to be able to determine afterwards the middle point, and the middle angle of incidence.

Mr. Bouguer, in his *Théorie de la Manœuvre*, Sect. I. Liv. III., ſhows that in moſt ſhips the angle of the rudder with the prolonged line of the keel ſhould be made to be 46° 40′. Without interfering with the calculations of that author, we ſhall perhaps find means of making plain to our readers what that able geometrician has ſo learnedly diſcuſſed in a more abſtruſe manner.

54. When it is required to turn the ſhip by means of the rudder, and, at the ſame time, to preſerve the head-way as much as poſſible, it is evident that the angle 54° 44′, which has been determined to be the moſt favourable with the line of the keel prolonged, is in that caſe too open; becauſe the water acts upon the rudder with too great a ſine of incidence, and which is equal to that of the angle which it makes with the line prolonged from the keel below. Above, the ſhock of the water is almoſt perpendicular to the rudder, on account of the width of the ſhip's ſides at the floating line towards the bottom, as has been remarked before. But if the rudder oppoſes the fluid by making only with the line prolonged from the keel an angle of 45°; the impulſe, by becoming weaker, will be leſs oppoſed to the ſhip's head-way; and the direction N P (*fig.* 19.) of the abſolute effort of the water on the rudder, drawing nearer the lateral perpendicular N L, will be more advantageouſly

ouſly placed; ſince the abſolute effort prolonged paſſes at a greater diſtance G R from the center of gravity G. On the other hand, experience ſhows us every day that ſhips ſteer very well when they do not make the angle D B E more than 35°; and if this angle be made 45°, as we require it, and then we ſhould come to diſcompoſe the abſolute effort N P, we find the ſide N I to be equal to the other ſide N L of the ſame ſquare; ſo that the part of the power total which oppoſes the head-way ſtands in this caſe but on an equality with that which produces the movement of rotation; whereas, were D B E 54° 44′, N I would become much greater than N L, in proportion to the ſines of the angles which are oppoſed to them in the triangles P I N or P L N, and the ſhip would of courſe loſe much more of her velocity than in the firſt ſituation of the rudder, to which we ſhall confine ourſelves, as being that part which ſuits beſt the generality of veſſels, but which muſt nevertheleſs be ſometimes altered, according as they ſhall be found to make an angle more or leſs open with their ſides a-ſtern.

It will always be eaſy enough to determine the angle of the rudder with the keel, by obſerving the rule we have preſcribed (n. 28.) in ſpeaking of the determination of the angle of the ſails.

REMARKS.

55. As the water often ſtrikes the rudder with a very great force, one has been under the neceſſity to give the lever, by means of which it is put in action, a certain length, in order to diminiſh the effort the helmſman is obliged to make in moving it, to regulate the ſallies the ſhip is continually making in the courſe of her navigation.

To leſſen ſtill more the effort of the helmſman, there is in moſt ſhips, on the quarter-deck, directly over the extremity of the tiller, a vertical wheel (*fig.* 19.), which has the effect of a cap-

ſtern,

ſtern, by means of a white rope, which, after having been wound ſeveral times round the cylinder of that wheel, is ſtopped above in the middle: the two ends are then paſſed, in a fore and aft direction, athwart one another, through two longitudinal openings made on the quarter-deck, on each ſide of the barrel of the wheel, in order to repaſs on two ſheaves placed in a block perpendicularly under the aforeſaid openings. The channels of the block are placed obliquely, in order to correſpond with two other blocks fixed cloſe to the ſhip's ſide, at the points F and F (*fig.* 19.), where the end of the tiller B F touches when the rudder is in its moſt oblique ſituation. Theſe two blocks receive the rope, which thence goes to the head of the tiller, where it is faſtened. So that, if the wheel be turned either one way or the other, the extremity of the tiller approaches towards one of the ſides of the ſhip, and expoſes the rudder to the ſhock of the fluid.

56. The longer a lever is, the more effect it has when it acts with the ſame power: therefore, the longer the ſpokes of the wheel are, in proportion to the radius of the cylinder round which the rope is wound up, the more advantage the helmſman will have; for, if the ſpokes of the wheel be three or four times longer than the radius of the cylinder, the helmſman will act with three or four times more force, ſince he acts on a lever which is three or four times longer than the radius of the cylinder the extremity of which is ſuppoſed to be the fulcrum of the lever on which he acts. So that, if the effort of the helmſman be equal to 30 pounds weight, he will produce an effect of 90 or 120 pounds by the mere diſpoſition of the wheel only. On the other hand, the impulſe of the water is united in the middle of the breadth of the rudder, which is very narrow, if compared to the length of the tiller; therefore, the effort of the water is at a very trifling diſtance from the point of ſupport B upon which it turns: whereas the tiller forms the arm of a lever 10 or 15 times longer, which ſtill increaſes the

power

power of the helmſman in the ſame proportion as is between the length of the tiller and that of the lever on which the impulſe of the water acts. This force is therefore 10 or 15 times ſtronger; and the effort of 30 pounds, which before gave the helmſman a power of 90 or 120 pounds, will become one of 900 or 1800 pounds on the rudder. The cauſe of this advantage is, that the ſhock of the water acts on a very ſhort arm of a lever, while the ſteerſman acts on one very powerful in compariſon to the other; and, that this lever is moved by a wheel which ſtill multiplies its force. This demonſtration ought to remove the very great ſurpriſe ſome perſons expreſs at the prodigious effect of the rudder, when they do not pay attention to its mechaniſm; for, they have only to conſider the preſſure of the water, which acts at a very great diſtance from the center of gravity G of the ſhip, as well as from the point C upon which it is ſuppoſed ſhe turns (n. 15.); and they will ſoon eaſily perceive the difference there is between the effort of the water againſt the helmſman, and the effect of that ſame impulſion againſt the ſhip: for, with reſpect to the helmſman, the water acts with the arm of a lever N B very ſhort, of which B is the point of ſupport or fulcrum. On the contrary, with reſpect to the ſhip, the impulſe of the water acts on a direction N P, which paſſes perpendicularly at a very great diſtance from the center of gravity G, in acting on a very long lever E G, which renders the action of the rudder very powerful in turning the ſhip; ſo that, if, in a large ſhip, the rudder receives an impulſe from the water of 2700 or 2800 pounds (as is very often the caſe, provided that the ſhip ſail at the rate of 9 or 12 knots, and that this power, applied at E, be 100 or 110 feet from the center of gravity G), it will act upon the ſhip to turn her with a power equal to 270,000 or 308,000 pounds, while, in this laſt caſe, the helmſman may very well act with no greater a power than one of 30 pounds only, on the ſpokes of his wheel.

57. It

57. It may not be improper to remark here, that the great length generally given to the tiller, in order to facilitate the operations of the helmſman, is an obſtacle to the play of the rudder; ſince that length hinders its preſenting itſelf ſufficiently to the ſhock of the water to produce all the effect which may be expected from it. For, this inconvenience does not, in moſt ſhips, allow the rudder to make the angle D B E (*fig.* 19.) more open than 30°; whereas it ſhould be 45°, as has been made appear before.

But, as this moſt favourable determination has not yet been made uſe of, but the coarſe dimenſions commonly given the tiller have always been followed, we think ourſelves under an obligation to correct that error, and to propoſe ſomething better for practice.

It muſt be conſidered, that if the tiller was ſhorter, the rudder would have more play, becauſe the extremity of that lever, in deſcribing the arc of a ſmaller circle, would occaſion the rudder to make an angle more open, with the keel prolonged: and this new augmentation would be ſo much the more advantageous, as it would come nearer the angle of 45°, which we have adopted for the beſt. And as in all ſhips the length of the tiller might certainly be cut a fifth ſhorter, or perhaps more, it is evident that, by ſuch means, the angle of the rudder and the keel prolonged might be rendered very near 45°, which would increaſe its force in a proportion as 3 is to 5, ſince the ſquare of the ſine of incidence of 45° is to the ſquare of the ſine of incidence of 30° : : 5 : 3, or thereabouts.

This augmentation of the impulſe is often of the greateſt importance, eſpecially in the full evolutions one has ſometimes occaſion to make ſhips go through, and above all when they are of a large ſize, as their motions are but ſlow on account of their length.

If the tiller be ſhortened, the helmſman will be obliged to employ more force in proportion to the length taken from the lever on which he now acts; but this loſs may be repaired by the facility with which the helm ſhall be handled, if the diameter of the cylinder

cylinder of the wheel be a great deal leſſened, at the ſame time augmenting the length of its axis without diminiſhing that of its ſpokes, which ought on the contrary to be lengthened as much as poſſible, and let two turns more of the tiller rope be wound round the barrel.

THESE forces would be ſtill much more multiplied, if two ſheaves were fixed in the end of the tiller, in two mortices which might be made for that purpoſe, with an iron pin paſſing through their centers, and taking care to have the end of the tiller well hooped with iron, in order to ſtrengthen it; then the tiller rope might be reeved through the blocks which are for that purpoſe on each ſide the ſhip, and thence through the two ſheaves at the end of the tiller, and the ſtanding part to be affixed cloſe to the blocks on each ſide of the ſtarboard and larboard. By theſe means nothing would be loſt with reſpect to the force; becauſe, if the lever be ſhorter, the forces which cauſe its action are likewiſe multiplied in proportion.

58. AFTER what has been ſaid reſpecting the helm, it is eaſy to conceive that the greater the ſhip's velocity is, the more powerful is the action of the rudder, ſince it acts againſt the water with a force which increaſes as the ſquare of the velocity of the fluid (n. 3.), whether the ſhip has head-way, or ſtern-way; always recollecting, that in theſe two circumſtances its effects are oppoſite; for, if the ſhip goes a-ſtern, the rudder will be ſtruck from I to N (*fig.* 19.); and inſtead of being puſhed from N to P, it will be ſo from N to R; ſo that the ſtern moving in the ſame direction, the prow of courſe muſt take a contrary one, and move towards the ſame ſide that the tiller B F is on*.

59. IT

* It may be objected to this new mode of increaſing the purchaſe of the helmſman, here propoſed by Mr. BOURDE', that it will prolong the motions of the rudder:

 I grant

59. It ought to be obſerved, in the uſe of the rudder, that there is one part of its effort which is hurtful to the ſhip's ſailing when it is ſtruck by the water which runs rapidly along the ſhip's bottom. If it makes an angle of 45° with the keel prolonged, then it receives only half the impulſion it would if the fluid acted upon it perpendicularly; becauſe there are two cauſes for the abſolute impulſe diminiſhing (n. 7.): firſt, The ſurface which oppoſes the ſhock of the water is reduced to a leſs extent than it was at firſt, and the angle of incidence diminiſhes likewiſe: ſo that, in this caſe, the impulſe has diminiſhed one half. The next cauſe to be conſidered is that ſame impulſion N P which remains (*fig.* 19.); for, it will appear then that there is only one part N I which is oppoſed to the ſailing (n. 54), and which is leſs than N P in the proportion as the ſine total is to the ſine of 45°, the meaſure of the angle of incidence W N B equal to N P I; for the angle W N L is right, as well as the angle P N B; ſo that, if you take away the common angle L N B, the two angles P N L and W N B will remain equal between themſelves; but, as the angle I P N is equal to its alternate angle P N L, it follows that I P N is always equal to W N B, whether the angle made by the rudder be more or leſs open with the keel prolonged. So that, if the ſurface of the rudder which receives the ſhock be 80 feet ſquare ſuperficies, it will firſt be reduced, by the manner in which it is expoſed to the courſe of the fluid, to an effort of 40 feet ſurface, then to 28 or 29, becauſe, in the firſt place, there is but one part of the velocity of the water which

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I grant it will to a certain point; but, when the diſparity of the arcs deſcribed by the tiller are conſidered, the difference will be found but trifling, and cannot (I imagine) come in competition with the many great and good effects which muſt neceſſarily attend the increaſe of the angle of the rudder with the keel prolonged.

which contributes to the ſhock, and that part is proportional to the relation between the ſquare of the ſine total and that of the ſine of incidence; and, ſecondly, becauſe out of the abſolute impulſe N P, which reſults from this laſt oblique ſhock, there is only a part N I which oppoſes the velocity of the ſhip proportional to the abſolute N P, in the ſame ratio as there is between the ſine total and the ſine of incidence; that is to ſay, that when the rudder makes, in the largeſt ſhips, an angle of 45°, it impedes the ſhip's rapidity of ſailing, in the direction of the keel, with an effort N I equivalent to the impulſion which a ſurface of 28 or 29 feet ſquare might receive, if it was expoſed perpendicularly to the ſhock of the water. So that, if the ſhip runs 12 knots an hour, or 19 feet a ſecond, the effort of the rudder N I, which oppoſes the rapidity of the ſailing, will be 12,499 or 12,945 pounds, as ſalt water weighs $\frac{1}{35}$ more than freſh.

OBSERVATIONS.

60. It follows, from what has been ſaid of the rudder, that it ought to be uſed as little as poſſible; that is to ſay, the ſhip and and her ſails ought to be ſo diſpoſed, that the ſmalleſt motion of this machine may bring her to her courſe, if ſhe deviates from it, or make her perform any evolution which may be thought requiſite.

ARTICLE III.

The time employed by different veſſels to perform the ſame evolution, is as their length.

61. All that tends to produce motion in ſhips, has more force in the larger than in the ſmaller ones; but the difficulty which

large ſhips experience to receive the motion is greater, in a greater proportion, than that which oppoſes the motion of ſmall ſhips. For, if the dimenſions and machines which enter into the compoſition of a large veſſel, have twice the magnitude of thoſe which conſtitute a ſmall one, ſolidities being in ratio of their cubes, the firſt will be eight times as great. Yet the obſtacle which the large ſhip will oppoſe to its being put in motion will be two and thirty times as great as that of the ſmall one. For, if both ſhips were conſidered as divided into an equal number of vertical ſections, thoſe of the large would ſoon appear to have four times as much ſurface as thoſe of the ſmall, beſides that they would be twice as thick, ſince the dimenſions are in general twice as large; conſequently they will have eight times the ſolidity; which anſwers already to the relative effort of the rudder and ſails.

AGAIN, the parts of the large ſhip are twice as diſtant from the center of gravity as thoſe of the ſmall one, ſince thoſe diſtances are proportional to the other ſimple dimenſions of the two ſhips. So that, if the evolution be ſuppoſed of the ſame number of degrees, the extremities aft and forward of the large ſhip will have to deſcribe arcs twice as large as the ſmall one; and this greater velocity being multiplied by the ſolidity of the parts of the large ſhip, which is eight times as great as that of the ſmall one, the product will give 16 times more motion; the reſiſtance, or *vis inertiæ* *, will act conſequently 16 times as much on the large as on the ſmall; and as that reſiſtance operates on the arm of a lever twice as long,

* *Vis inertiæ*—Is a force which reſides in bodies at reſt, or in motion. It is that force, which cauſes them to reſiſt motion when at reſt, and oppoſes being ſtopped when put in motion. The firſt we experience every day when any thing is moved; and the ſecond will manifeſt itſelf if an attempt be made to ſtop ſuddenly a body in motion. TRANSL.

long, the momentum* or total reſiſtance of the large ſhip will be 32 times as great. Therefore, ſhould the forces which act on the large ſhip be augmented no more than in proportion to her ſolidity, ſhe will have ſtill four times more difficulty than the ſmall one to get into motion. Therefore the large ſhip, inſtead of making in the ſame ſpace of time an angle of rotation as great as the ſmall one, will only make an angle of one fourth, or, in other words, three times leſs. Now, that the great ſhip ſhould deſcribe an angle of rotation equal to the other veſſel, it will require only thrice as much time: but that angle, or the velocity with which the ſhip obeys the impulſe of her rudder and ſails, will follow the laws of acceleration, ſince the velocity acquired in the firſt inſtant is continually augmenting in an arithmetical progreſſion; ſo that the time which ſimilar veſſels of different ſizes take in performing the ſame evolution, will be in proportion to their lengths.

THE heavier a body is, the greater is the effort neceſſary to put it in motion: *vice-verſâ*, the more difficulty there is found in putting a heavy body in motion, on account of its volume three times as heavy as that of a ſmaller one compared to it, the more difficulty, of courſe, will be found alſo in the heavieſt body to make it loſe the velocity of that movement once impreſſed on it, comparatively ſpeaking, with the difficulty found in performing the ſame operation on a ſmaller body. For, this having been put in motion with three times the facility, will be ſtopped with the ſame eaſe. The reſiſtance

* *Momentum*, in mechanics, is the produce of the maſs of any body whatever by the diſtance of its center of gravity, from a point taken at pleaſure. The *momentum* of a body which falls, is the product of its maſs, by the velocity acquired in the firſt inſtant of the ſhock. The *momentum* of a force, which acts on the arm of a lever, is the product of that force by the diſtance from the fulcrum or point of ſupport. TRANSL.

reſiſtance a body oppoſes to loſe a movement is always equal to that employed by the ſame to acquire it. So that, if a veſſel 100 feet long takes four minutes to perform an evolution, a ſimilar veſſel of 150 feet will take ſix minutes or thereabouts to perform the ſame circular movement. 100 : 150 : : 4 : 6. *Q. E. D.*

END OF THE FIRST PART.

AN

Fig: 1st.

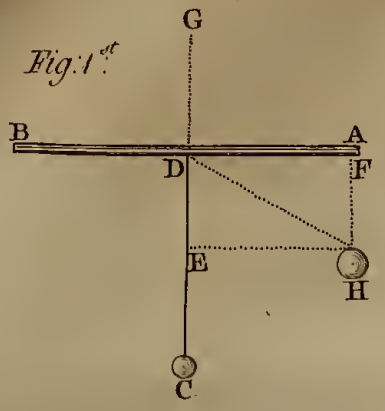
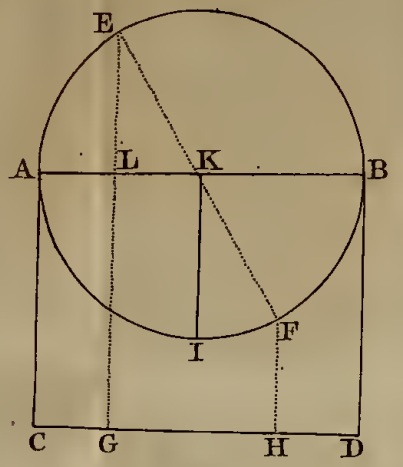


Fig: 2d.



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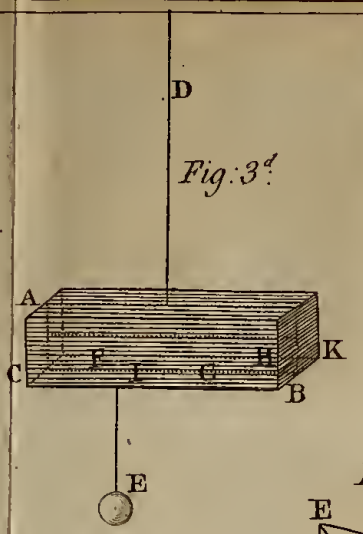

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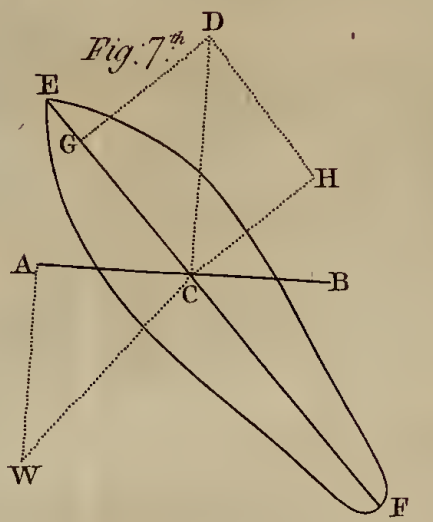

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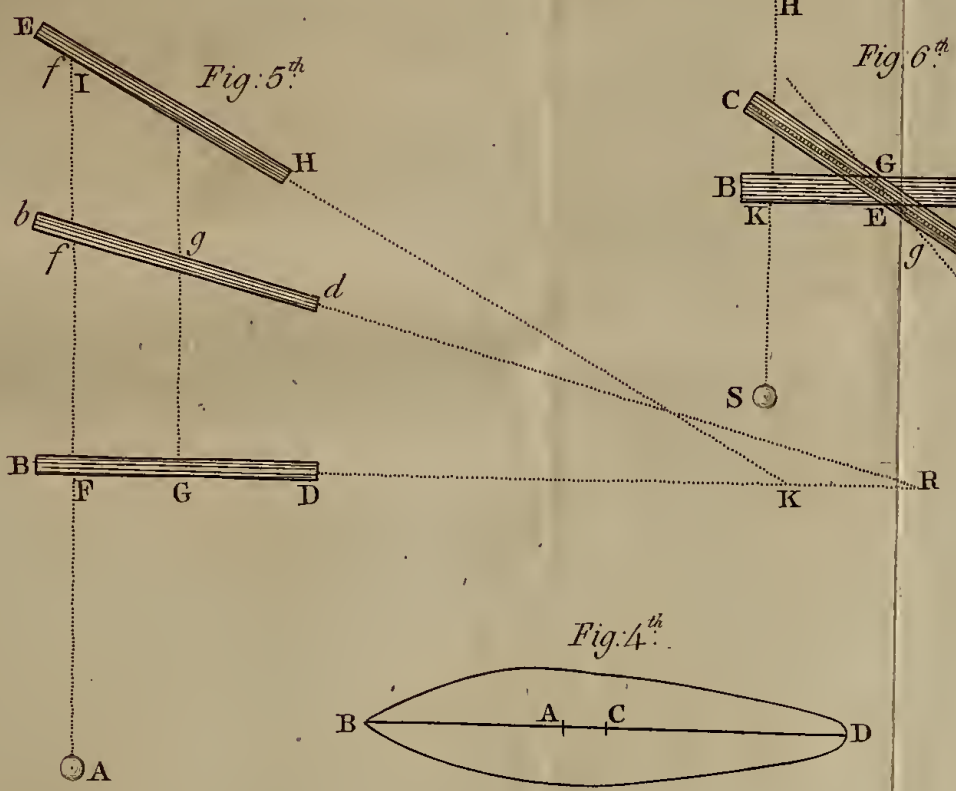

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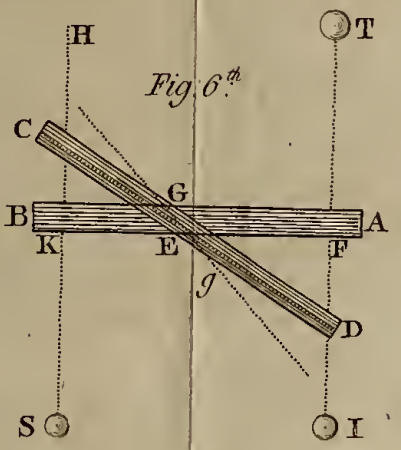
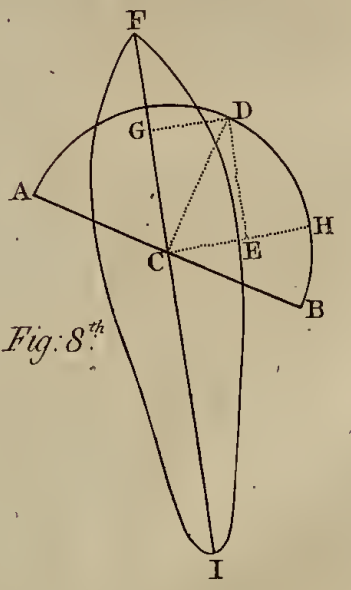


Fig: 4th.

Fig: 8th.



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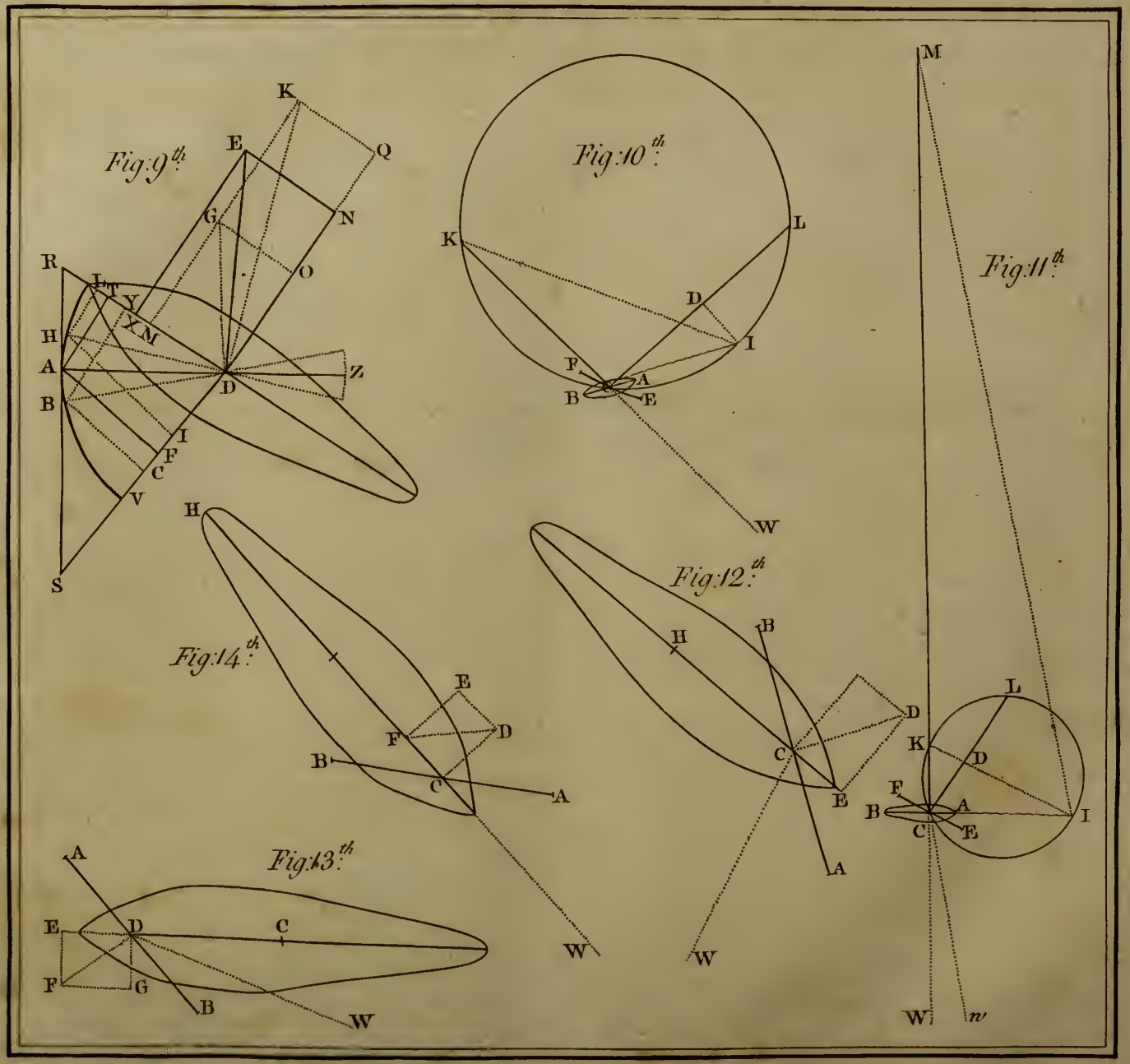

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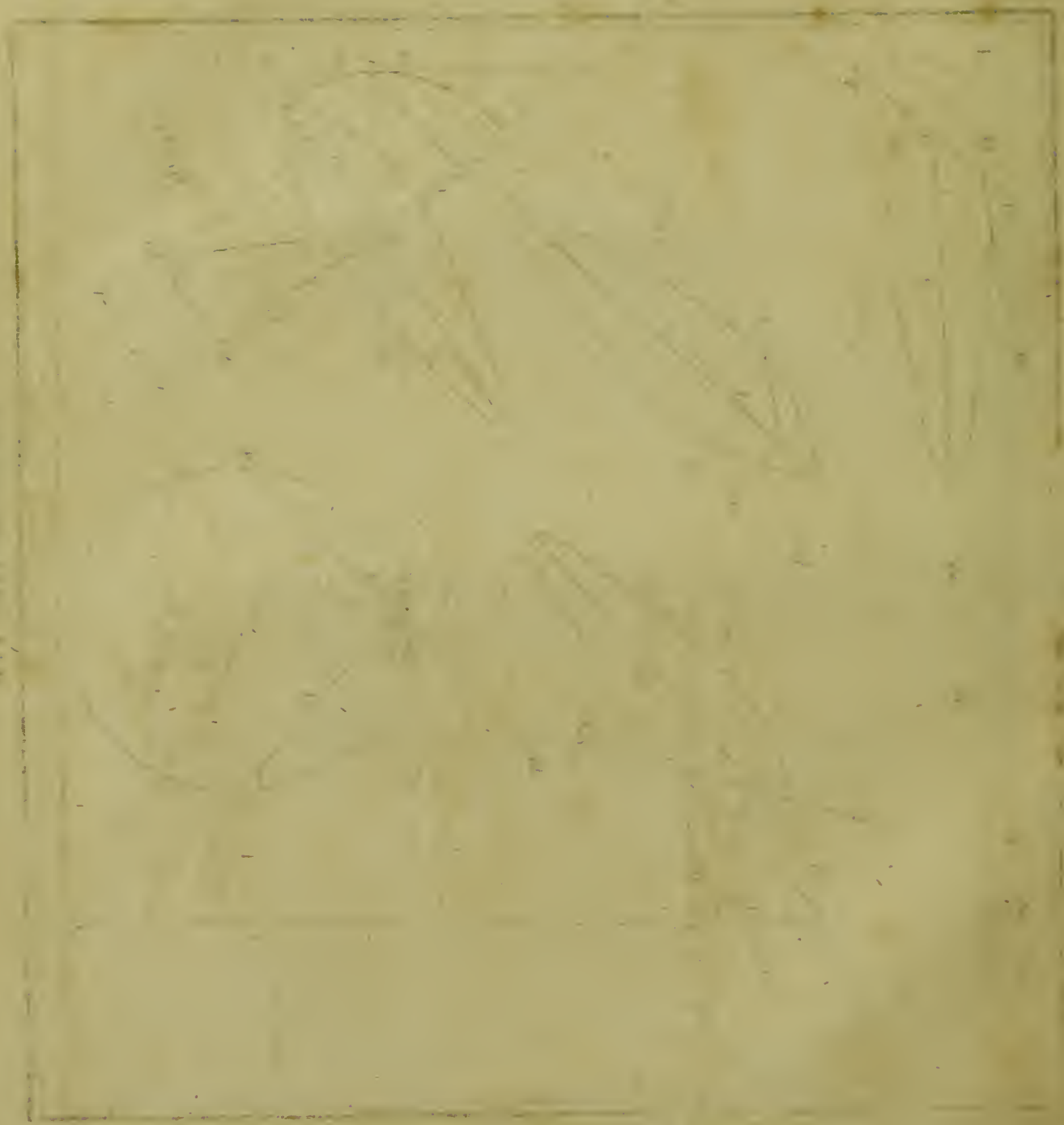

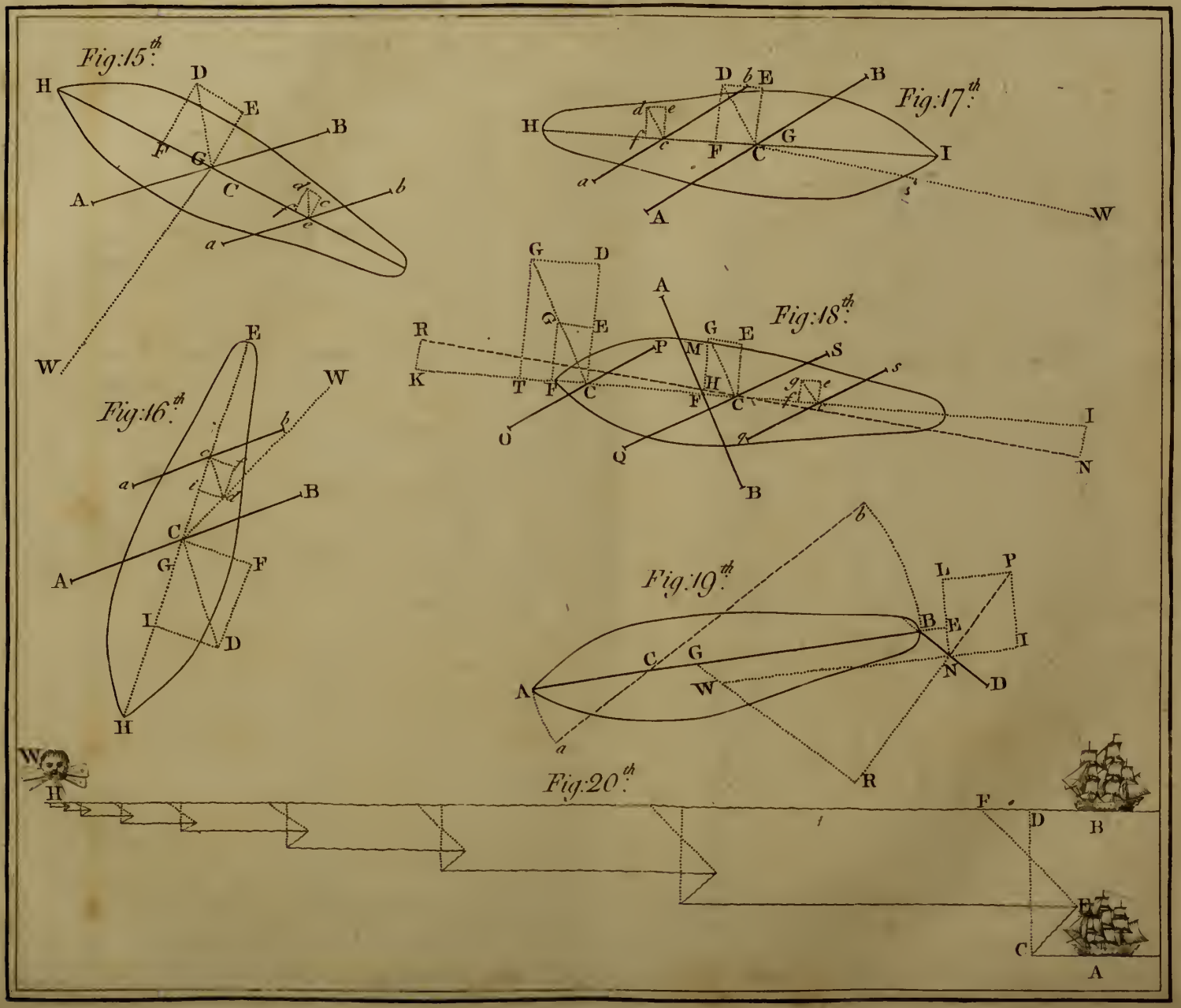

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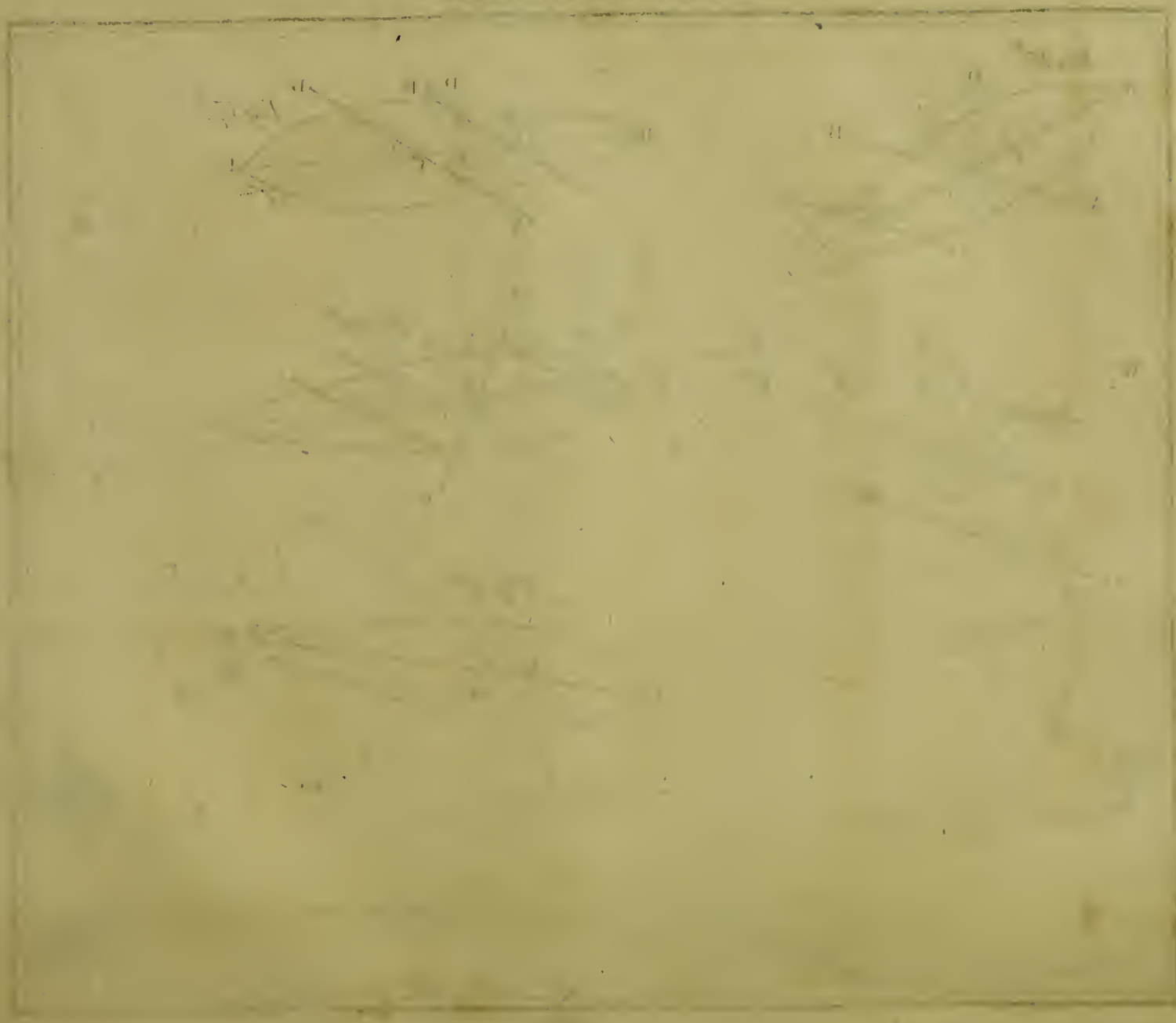

AN

ESSAY

ON

NAVAL TACTICS.

PART THE SECOND.

The Theory applied to Practice; or, a Demonstration of the Evolutions of a Ship.

WE are now entering into the most brilliant part of the Seaman's duty, which requires him to be continually in action, and always availing himself of the theoretical knowledge he possesses, in order to apply it with judgement to practice: which will enable him to dispose of the machinery which composes and guides the ship with such skill as to place her with the greatest expedition in any required position.

CHAPTER

CHAPTER I.

Of getting under ſail.

ARTICLE I.

PROBLEM I.

To get under ſail when the ſhip is ſwinging head to wind, and you want to caſt to ſtarboard in a place where there is no current.

SOLUTION.

YOU muſt heave ſhort on your anchor till it is a-peek: then haul in ~~quite home~~ the larboard braces forward, and ſtarboard braces abaft: looſen, ſheet-home, and hoiſt the top-ſails, ſhould they not be ſo already: put the helm a-ſtarboard, and heave round till the anchor is a-weigh. The moment the anchor quits the ground, the ſhip will begin to fall off to ſtarboard; a movement which you no ſooner perceive her to make, but you muſt help her by ſetting the jib and fore-top-maſt ſtay-ſail: and when ſhe has ſufficiently fallen off, her ſails abaft (which are trimmed ſharp for the larboard tack) will fill. But, unleſs it is for very ſuperior reaſons, you had better to continue lying-to till the anchor is catted, taking care however to haul the mizen-ſheets cloſe aft, if the ſhip be inclined to fall off too much.

DEMONSTRATION.

DEMONSTRATION.

You heave ſhort before the top-ſails are looſened, in order to facilitate the manœuvre of the capſtern, which would act with too much power, if they were ſet; ſince they would be a-back, and conſequently in a ſituation to ſend the ſhip a-ſtern; whereas ſhe ſhould go a-head when you are heaving on your cable. The larboard braces are hauled in forward, becauſe, in that ſituation, the ſails are ſo braced as to caſt the ſhip's head to ſtarboard, ſince they make with the keel the moſt acute angle poſſible a-ſtarboard forward, and are at the ſame time a-back. Beſides, the after-ſails being braced up to ſtarboard and ſharp trimmed, are alſo taken a-back like the others, and receive the wind in ſuch a manner as to turn the after-part to port. Therefore, there are always two powers acting in contrary directions, one before and the other abaſt the center of gravity of the ſhip; the one forces the fore-part to ſtarboard, and the other impels the after-part to larboard.

As theſe two effects cannot happen without the ſhip going a-ſtern the moment the anchor quits the ground, ſince ſhe is no longer with-held by any thing, and is moved by an exterior fluid power which carries her in this direction, part of the effect of her ſails giving her ſtern-way (n. 21.); it follows, that the helm muſt be put to ſtarboard, that the rudder may help her after-part round to larboard (n. 58). By theſe means every thing is diſpoſed to make the ſhip fall off to ſtarboard; which is the ſolution of the whole problem; recollecting however that what we call the jib and fore-top-maſt ſtay-ſail are not added to the evolution, unleſs there be reaſons to fear the ſhip will not fall off faſt enough; and when you find ſhe has ſufficiently done ſo, the mizen is to be hauled out, to procure the contrary effect, and thereby to counterbalance the jib and ſtay ſail, which it is very often neceſſary to keep ſet.

REMARKS.

If there was an abſolute neceſſity to caſt to port, you ſhould then haul-in the ſtarboard braces forward, and the larboard braces aft, and put the helm a-port; the reſt of the manœuvre is the ſame as in the preceding caſe, and could be proved by the ſame reaſoning; only changing, in the demonſtration, ſtarboard for port, or larboard.

If a ſhip, riding head to wind and tide, wanted to get under ſail; after having decided which ſide it is beſt to have her caſt, you muſt manœuver according to one of the foregoing methods, except the helm, which muſt be put to ſtarboard, either before the anchor looſens, or while it does, if you wiſh to caſt to port; becauſe the water, coming from forward, acts with the ſame force on the rudder as if the ſhip went along with the current, and impels the rudder to ſtarboard, and the head to port. Therefore, it is evident, in this caſe, the helm ought to be put to ſtarboard; which, on the contrary, would be put to larboard, was the ſhip to be caſt to port.

If the ſhip, after the anchor is out of the ground, went a-ſtern faſter than the current runs, the helm muſt then be uſed as if there was no current, becauſe the exceſs of velocity, whereby the ſhip exceeds that of the water, acts upon the rudder.

If it blows freſh, ſo that you cannot ſet your top-ſails without reefing them, let that be done before they are ſheeted home; and if it blew ſo hard as to compel you to ſail onward with only your fore-ſail, it would be then ſufficient to looſen the fore-top-ſail, without tallying it, after having braced it quite cloſe on the ſide oppoſite to that you want the ſhip to caſt, not forgetting however to put the helm the ſame way as you caſt, as ſoon as you perceive the ſhip going a-ſtern; and when the ſhip has fallen off ſufficiently, then is the time to fill and trim the fore-ſail.

ARTICLE II.

PROBLEM II.

To get under ſail when the ſhip is ſwinging with her head to the current, and with the wind a-point abaft the beam.

SOLUTION.

THE top-ſails being furled with rope-yarns, let them and the mizen top-ſail be hoiſted, and properly trimmed, as if they were ſet; and when every thing is properly diſpoſed, heave ſhort on your anchor till it is a-peek; next to this, looſen, ~~tally~~ ſheet home the fore-ſail and mizen top-ſail, keeping the wind in, and heave quick and vigorouſly the capſtern till the anchor is a-weigh. At the ſame time hoiſt the jib and fore-top-maſt ſtay-ſail, or haul out the mizen, according as circumſtances may require. Whether you wiſh to come to windward, or fall off more quickly, you muſt ſtill continue to heave round the capſtern briſkly to get the anchor up, till you find yourſelf ſufficiently offward to bring to, in order to ſtow it with eaſe, or to ſtand on under an eaſy ſail with the anchor hanging out to windward, if the ſituation of things will admit of it. You may ſometimes alſo hoiſt up both the main and the fore top-ſails, as ſoon as you get ready; but, in certain caſes, when obliged to make the beſt of your way and ſail at the ~~higheſt~~ greateſt rate, every ſail poſſible muſt be ſet at once which the weather will admit of; eſpecially when obliged to haul by the wind; in which caſe, the anchor muſt be got up and catted as well as it can: there are caſes even when, without loſing your time in weighing it, you crowd as many ſails as you poſſibly can, and depart in cutting the cable, or veering it end for end.

DEMONSTRATION.

THE top-ſails and the mizen top-ſail are hoiſted up, becauſe the ſails in that ſituation are eaſier ſheeted home and trimmed; and becauſe, as ſoon as the rope-yarns are cut, the ſails fill, and give celerity to the ſhip, which ſails onward the moment the anchor quits the ground. The mizen top-ſail is uſed to make the ſhip ſteer well, as one has it in one's power to keep it either filled or looſe to the wind, according as the ſhip is griping or the contrary; beſides the aſſiſtance of the rudder, which is to be employed as ſoon as the ſhip begins to move.

REMARKS.

IT happens ſometimes, in getting under ſail, that you are obliged to heave the anchor up to leeward; which often gives a dangerous ſtrain to the capſtern; becauſe the ſhip, driving to leeward as ſoon as the anchor is a-weigh, cauſes the cable to gird againſt the lee bow, and the ſtock of the anchor is very apt to catch the cut-water. To avoid this embarraſſment, let the ſhip (if you are near the land) get offing enough to wear and bring the anchor on the weather bow.

I WAS once in ſuch a ſituation as is here mentioned, and was obliged to perform this manœuvre, which is not difficult to conceive; becauſe the ſhip, lying to leeward of the anchor, or ſtanding on under an eaſy ſail, drifts, and conſequently leaves the anchor diſengaged to windward; which enables us to heave it up with facility.

ARTICLE III.

PROBLEM III.

To get under ſail with a ſpring.

SOLUTION.

If a ſhip be in a place too much confined to caſt under her ſails only, or if one is obliged to put to ſea in a gale of wind, without lifting the anchors; you muſt, for greater ſafety, and in order to facilitate the falling off, caſt a ſpring out, to be clapped on the cable by which the ſhip ~~lies~~ rides, by getting a hawſer or a ſtream-cable to paſs through the aftermoſt port, on the oppoſite ſide to that you mean to caſt; and, after that ſpring is well heaved taught at the capſtern, hoiſt the jib and fore-top-maſt ſtay-ſails, looſe, and ſheet home the fore-top-ſail; then, when that is done, and if the weather permits, brace quite cloſe the head ſails on the ſame ſide with the ſpring: and, when this is executed, ſlip or cut the cable, heaving briſkly at the ſame time on the ſpring, till the ſhip has paid off ſufficiently. Then, when you find ſhe has Caſt enough, you fill the ſails, in ſetting the mizen-top-ſail and every other ſail you mean to employ, and ſlipping the ſpring if you have time enough, for if you have not you muſt cut it ~~off~~ inſtantly. Care muſt be taken, in performing this manœuvre, not to let the ſhip fall off too much before the ſpring is cut; becauſe, having no way through the water, ſhe cannot be brought to the wind ſo ſoon as might be wiſhed; *which may be productive of bad conſequences in a narrow place:* and, for the ſame reaſon, the ſpring muſt not be cut, till the ſhip has fallen off as much as is neceſſary; becauſe although ſhe has no other motion but that of falling off, the veſſel might perhaps not wear enough to anſwer the purpoſe.

DEMONSTRATION.

DEMONSTRATION.

THE reaſons having been ſhewn before why the head ſails are braced up on the oppoſite ſide to that which the ſhip caſts, they ſhall not be repeated here; although we ſuppoſe the wind ſo ſtrong as to keep the ſhip wind-ridden. I ſhall only undertake to prove, that the ſhip turns almoſt on the middle of her length; ſince the moment the fore part begins its movement of falling off on one ſide, the after part makes another to approach the point from which the head is receding. Now, ſhe turns ſo much the more ſurely on her center, and her evolution is ſo much the more rapid, as the force uſed in heaving at the capſtern is ſtronger: becauſe the more powerful the heaving is, the more of the hauſer comes in, and conſequently the more eaſily and with the greateſt rapidity will the after part approach the point the head of the ſhip has left.

WHEN ſhe has fallen *off* enough *to fill the ſails properly*, ſlip the ſpring, becauſe ſhe gathers head-way in proportion as the ſails are filling, and in that caſe the hawſer would only hinder the ſhip going a-head, or cauſe her to fall off more, which would be prejudicial to the evolution. The hawſer or ſtream cable is paſſed aft as far as poſſible; becauſe, being at the extremity of the ſhip, the capſtern ſtrains leſs, and the veſſel turns with more celerity.

OBSERVATIONS.

IF this manœuvre is performed when it blows hard, you muſt not ſheet home the fore-top-ſail: for, if the wind is abſolutely too ſtrong, you muſt content yourſelf with only looſening this ſail, and hoiſting the fore-top-ſtay-ſail: but, if the weather is pretty tolerable, it will be found ſufficient to ſheet home the fore-top-ſail without hoiſting it.

ARTICLE

ARTICLE IV.

General remarks on getting under ſail.

WHENEVER a ſhip is going to ſail onward, ſhe muſt, before her ſails are ſet and as ſoon as the anchor begins to quit the ground, have her top-ſails at the maſt-head ſtopped with rope-yarns. And indeed any veſſel which is proud of manœuvering with propriety and velocity, ought to obſerve this precaution when the weather will permit, no matter in what latitude ſhe may be. Such manœuvre is general, when the wind is not too powerful.

WHEN the tide takes the ſhip on the beam, and ſhe is to caſt the other way, it is evident that the tiller in the firſt inſtant muſt be put on the ſide the current runs from, becauſe the rudder will be in ſuch a ſituation as to receive very obliquely the impulſe of the fluid, and conſequently will but little oppoſe the ſhip's falling off, provided the ſhip's velocity does not exceed that of the current.

WHEN in a ſituation where caſting is indifferent, one way or the other, always let it be to leeward of the anchor, that there may be no riſk of its getting foul of the cut-water.

CHAPTER II.

PROBLEM.

To tack a ſhip, in getting to windward as much as poſſible.

SOLUTION.

TO execute this manœuvre with propriety, care muſt be taken that the ſhip does not yaw, that ſhe is not too much from, or near, the wind; becauſe both ſituations are equally prejudicial to the

the evolution: and when that preciſe point is attained, which is not very difficult, haul the mizen out, if it be brailed up, *(the power of which is careſully to be preſerved*)*, while you put at the ſame time the helm a-lee, and brace the bow-line quite to leeward, that the mizen may be as much as poſſible expoſed to the wind: and, when the ſhip is come to the wind, ſo as to cauſe the ſquare ſails to ſhiver, let go the jib and all the ſtay-ſail ſheets before the main-maſt: then, the moment all the ſails catch *a-back*, and particularly the mizen top-ſail, let it be braced ſharp about the other way; hauling up, at the ſame time, the weather clue of the main ſail; and immediately (the wind being right a-head, or even a little before) fill up the main-top-maſt's ſails: and trim ſharp for the other tack as faſt as poſſible.

The jib and ſtay-ſail ſheets are alſo to be ſhifted over at the ſame time, in righting the helm, whether the ſhip has loſt her way, or even ſtill advances a-head. Then, as ſoon as ſhe has paſſed the direction of the wind 45, in continuing her evolution, ſhift the fore-maſt's ſails, which are to be trimmed with all the ſame celerity in putting the helm a-lee, if you fear the ſhip (which muſt ſtill go a-ſtern if the manœuvre be ſlowly executed) will not fall off ſufficiently: for, if the ſails are braced about briſkly, ſhe will never have ſtern-way; on the contrary, ſhe will get a great deal to windward. Thus, every thing before directed being exactly executed, and the ſails well trimmed on the oppoſite tack, the problem is ſolved.

DEMONSTRATION.

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* For, the mizen operates as it were another rudder, by the action of the current of air upon its ſurface, and ought conſequently to have its impulſe preſerved as much and as long as poſſible. Moreover, it acts on a very long and neceſſarily very powerful arm of a lever to turn the ſhip. True it is, that part of its effect tends to leſſen the celerity of ſailing; but, is not the helm in the ſame predicament, and in a proportion to the magnitude of their ſurfaces, and of the denſities of the fluids to which they are expoſed? Transl.

DEMONSTRATION.

I SAID, and it remains now for me to prove, that it is prejudicial to the evolution, to be too near to, or too much from, the wind, previous to tacking a ſhip. In the firſt place, if too near the wind, when the helm is put a-lee, ſhe will probably miſs ſtays; ſince the ſhip, not having a ſufficient velocity, the rudder will not have all its neceſſary effect to cauſe the ſhip to double upon the critical point where all the ſails ſhiver. For, the power of the rudder to turn the ſhip, is proportional to the force with which the water ſtrikes it (n. 58). Hence it follows, if the ſhip has not ſufficient way through the water, the rudder will not have force enough to cauſe her to force over the point, or any thing elſe which can increaſe or keep up the rapidity of ſteering; and, of courſe, the power of the helm will ceaſe, the ſails being all ſhivering. The ſhip muſt then unavoidably fall off again, ſince the helm is a-lee, and not one of her ſails tends to ſhoot her a-head. On the contrary, her mizen-ſail being out, and braced quite to leeward, forces the ſtern and the ſhip athwart (n. 40.); while, by the wind which ſtrikes her ſails, rigging, and hull, ſhe is but too ready to drive a-ſtern; as a ſhip always finds great difficulty to divide the fluid laterally. Thus it is clear that, every thing being diſpoſed for driving the ſhip the ſtern-way, ſhe muſt infallibly both go a-ſtern and lee-ward (n. 58). This is confirmed by experience; for, whenever a ſhip miſſes ſtays, ſhe is viſibly perceived to fall abaft.

IF a ſhip is too much away, ſhe is much longer in ranging to the wind. Conſequently, lee-lurches, previous to tacking, are diſadvantageous and uſeleſs to the evolution, ſince they retard it.

I SHOULD not have mentioned this cuſtom, had I not ſeen many ſeamen, through mere habit, put it in practice, and fail, by this

movement, in their evolution; which would however have ſucceeded, had they not had the habit of letting go the fore-jib, and ſtay-ſail ſheets. When, as I ſaid before, theſe have been kept faſt, the edging away can only prolong the time of the evolution; but, if the fore, jib, and ſtay ſail ſheets be let go, as a great many do at every turn (and as in ſome particular caſes it is really found neceſſary), care muſt be taken by ſuch officers, not to ſuffer the ſhip to fall off too much: becauſe the velocity of the ſhip not being ſufficiently kept up (n. 46.), when the ſhip comes to the wind, it follows that ſhe has loſt a good deal of it, before ſhe is come to the critical part of the evolution, where all the ſails ſhake or ſhiver. So that, when the ſhip is at that point, the velocity is ſo much diminiſhed, that the rudder has not power enough to cauſe her to double it: on the other hand, the fore part of the ſhip is no longer carried to the wind with the ſame force, ſince the veſſel no longer ſhocks the fluid (n. 47.) with her firſt velocity.

The mizen is hauled out to help the rudder; becauſe theſe two forces act together in impelling the after part of the ſhip to lee-ward (nn. 40. & 50.), when the helm is a-lee, and the ſhip of courſe head to wind; which after part continues that circular motion, firſt by the effect of the rudder, till the head-way ceaſes; and then by that of the mizen, till the other ſails take the wind from it. Therefore, when the mizen is becalmed by the other ſails, the evolution is ſure, as this could not happen if thoſe ſails were not taken a-back.

You muſt wait till the ſquare ſails begin to ſhiver, before letting go the jib and all the ſtay ſail ſheets, which are before the main-maſt; becauſe, till that moment, theſe ſails concur to maintain an equilibrium with the others, and keep up the ſhip's velocity; ſince it is the diſpoſition of the different ſails ſet on the different parts of the ſhip, which gives her more or leſs way through the water (n. 46.), and becauſe then they are the only ones which tend to make

make the ſhip fall off (n. 31.), ſince they are the only ſails fit to be filled, the others being ſhivering. It is then abſolutely neceſſary at this moment to ſuppreſs their effect, ſince it is contrary to the movement of the ſhip, ſhe being to turn now with nothing but with the ſole effect of the rudder and the mizen, as her velocity has been maintained till this inſtant by all the ſails together, and which ſails ought, by all that has been ſaid, to ceaſe acting all at the ſame time, the mizen excepted, the action of which is to be preſerved as long as poſſible, in order to help the rudder, which, in keeping up the movement of rotation of the ſhip, will ſoon make her clear with activity the critical point of the evolution.

Experience has often taught me, that the motion of the ſhip, in coming to the wind, at the moment the jib and ſtay ſail ſheets are all let go, is very rapid, provided the other ſails ſhiver; becauſe, the velocity of the ſhip, at that moment, is as great as when all the ſails were expoſed to the impulſion of the wind. Conſequently, the effort of the rudder is likewiſe very powerful (n. 50), ſince the rapidity of ſailing has not diminiſhed.

The mizen ſail is to be braced up ſo far as to join the main ſhrouds to ~~lee~~ward, becauſe in that ſituation it is expoſed as much as it poſſibly can to the wind, and receives conſequently a ſtronger and longer impulſion*; and, again, becauſe it is trimmed for good, and keeps ſo, even after the evolution has been performed. It will not be difficult to conceive that reaſoning for any one of thoſe who are acquainted with the ſituation of that ſail, and who muſt know it cannot be braced but between the aftermoſt main ſhrouds.

The mizen top-ſail ſhould be filled as ſoon as it is taken a-back, becauſe, being ſuddenly cloſe hauled about for the other tack, it forces

* This is only neceſſary in light winds, when the ſhip's ſtaying is doubtful; and and then the ſpanker boom kept well to windward is of the higheſt utility.

forces the ſtern to leeward, as well as would the mizen (n. 44.), and, by this new diſpoſition, accelerates the evolution. Whereas, if it were left longer in its firſt ſituation, it would retard that evolution, by impelling the after part to windward (n. 45). Another reaſon for not ſuffering the mizen top-ſail to lie longer in its firſt ſituation, is becauſe it is ready ſet and trimmed, fit to be inflated by the wind, when turned about on the other tack, after the ſhip is fallen off, and thus become very uſeful, in moderating the ſtern and lee-way of the ſhip.

At this ſame time, the weather clue and ſheets of the main-ſail are to be hauled up, in order that all may be ready to brace round for the other tack.

The main-ſails are to be ~~filled~~ hauld when the wind is right a-head; becauſe, 1ſt, at this time the ſails on that maſt are becalmed by thoſe of the fore-maſt: 2dly, ſhould they be left longer in this ſituation, they would counteract the head-ſails (nn. 37, 38, 44, & 45.) which are braced up for the ſame tack, and in the ſame manner; and, finally, becauſe, were it not for this manœuvre, the fine of incidence of the wind on them would be continually increaſing as the ſhip were falling off, which would more and more retard her bearing away. It is therefore neceſſary they ſhould be changed at the moment when the fine of incidence of the wind which ſtrikes them is leſs than would another greater, by which they would undoubtedly be ſtruck if they were continued longer without being braced about, and than would likewiſe have been the other ſtill greater ſign of incidence by which they muſt have been ſtruck, had they been hauled as ſoon as they were taken a-back; which would have increaſed their power, in giving the ſhip ſtern-way. So that, the moment the wind is right a-head is the moſt favourable to haul about, and trim the ſails, on the main-maſt; for, if this were done ſooner, they would more ſuddenly ſtop the ſhip's head-way, and make her fall to leeward in decreaſing

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the effect of the rudder. It is, notwithſtanding, not untrue, that the evolution ſhould be more rapid, if the ſails on the main-maſt were ~~filled~~ *aquded* as ſoon as they are taken a-back: becauſe (n. 44.) they would impel the after part of the ſhip to leeward. But, this effect of the after ſails ought never to be attended to, except when the ſhip has loſt her velocity, and the rudder its power. Whence it muſt be derived as a concluſion, that the ſhip will always fall off with great celerity, as ſoon as the main-ſail is hauled.

The jib and ſtay ſail ſheets are alſo to be ſhifted at this very ſame time, if they have not been lowered before; becauſe, if ſooner, they would take the wind in again, which muſt not be done before the ſhip has fallen off ſufficiently to clear over the direction of the wind.

The helm is to be righted if the ſhip has loſt her way; becauſe, if it were continued a-lee, as in the firſt inſtant, and the ſhip ſhould get ſtern-way, the rudder (n. 58.) would oppoſe the evolution, which cannot miſs being finiſhed with ſufficient rapidity by the ſole effect of the head-ſails, as theſe are now fully expoſed to the power of the wind. For great care muſt be taken not to ſlack the bow-lines, as is often done by people who act more from cuſtom than reflection.

The head ſails are to be filled, when the ſhip has got over the direction of the wind by 45°, or thereabouts; becauſe, if they were left longer a-back, the motion of falling off the ſhip would become too rapid, and too great. If they are braced about briſkly at the time before mentioned, they may be made to ſhiver, which, by diminiſhing their effects, will moderate the great velocity of falling off the ſhip has acquired (n. 37).

The helm ought to be put a-lee (n. 58.) if the ſhip goes a-ſtern, in order to aſſiſt her falling off, which is now carried on by the mere *vis inertiæ* only, which cauſes her to continue to bear away, and by the jib and ſtay ſails before the center of gravity. Thus the

ſhip

ſhip falls off moderately, in yielding to the wind by 12° or 20° only, more large than if cloſe hauled; becauſe the after ſails, being trimmed ſharp, ſoon bring the ſhip to the wind, and give her headway (n. 41). Let it not be forgotten, that the helm ought not to be put a-lee in hauling off all, unleſs you judge the ſhip not ſufficiently inclined to fall off, which ſeldom happens when ſhe is come to this point.

OBSERVATIONS.

THE demonſtration of this evolution comprehends the whole play of the ſails and of the rudder; ſo that all other demonſtrations might be conſidered as ſo many corollaries deduced from it.

REMARKS.

THERE are circumſtances ſometimes when it is found neceſſary to tack, without caring much whether the ſhip looſes to windward. For example; when a ſhip is found ſuddenly to be cloſe to the land; in the night, or in foggy weather; near a danger, or ſome veſſel, which muſt inſtantly be avoided by ſtaying the ſhip, becauſe you find yourſelf to windward and too near the object from which you wiſh to recede. In this caſe, when it is neceſſary to deaden the ſhip's way, and tack at the ſame time, you muſt ſuddenly put the helm hard a-lee; and, in the ſame inſtant, let go the jib, fore, and ſtay ſail's ſheets, without touching the bow-lines*; and when the ſails

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* Care muſt be taken that the effect of the mizen is preſerved as much as poſſible; if the head ſails take properly a-back and bring her round, the reſt of the evolution is the ſame as in the foregoing problem; but ſhould the ſhip miſs ſtays, proceed according to the ſecond method of veering, called box-hauling†. TRANSL.

† Vide (n. 2.), Chap. III.

ſails begin to ſhiver, the mizen is to be hauled quite in the lee braces: then, if the ſhip takes well the wind a-head, the remainder of the manœuvre muſt be executed as before directed in the other caſe: but if you ſhould come to miſs tacking, we ſhall adviſe what is to be done in the ſecond method of veering.

DEMONSTRATION.

It is eaſily conceived that, in letting go the fore, the jib, and the ſtay-ſails ſheets, the ſhip's head-way will be diminiſhed (n. 46), while, at the ſame time, almoſt all the forces forward are taken away which might hinder her coming to the wind (n. 31.): therefore, the ſhip muſt come to it rapidly by the effect of her after ſails (n. 41) which are trimmed ſharp, and by the power of the helm (n. 50), till all the ſails ſhake. It is alſo eaſy to conceive that when the mizen is hauled in the lee braces, it has a greater power to impel the after part of the ſhip to leeward, and the ſails conſequently to take a-back. So that the ſhip's head-way will the ſooner be ſtopped; and, the fore ſheet being gone, the ſail to windward makes a large cavity between the maſt and ſhrouds; which very much contributes to ſend the ſhip a-ſtern. Attention ought therefore to be paid to catch the inſtant, when the head-way ceaſes, to ſhift the helm and aid the ſhip in her evolution; as we hinted already. The reaſon this method is not always practiſed, is becauſe the ſhip would loſe a deal of ground in driving to leeward, in wearing thus. It ought, therefore, never to be uſed but when neceſſity obliges, and the veſſel has good way through the water; for, if ſhe has not, ſhe will generally by this manœuvre miſs ſtays; in which caſe, you are to act according to the ſecond problem in the following Chapter*.

CHAPTER

* The head bow-lines are never to be checked; the reaſons are obvious to every thinking ſeaman; there is therefore no occaſion for further comment. Transl.

CHAPTER III.

ARTICLE I.

PROBLEM I.

To veer a ſhip, without looſing the wind out of the ſails.

SOLUTION.

TO execute this evolution, both the main-ſail and mizen muſt be hauled up, the helm put a-weather, and the mizen top-ſail a-ſhivering, which will be kept ſo till the wind be right aft, ſuppreſſing for that purpoſe the effect of all the ſtay-ſails abaft the center of gravity. As the ſhip veers (which ſhe will do very rapidly), round in the weather braces of the ſails on the fore and main maſt, in keeping them exactly trimmed to the direction of the wind, and remembering alſo the bow-lines are not to be ſtarted till the ſhip begins to veer. Then, as ſhe falls off, eaſe away the fore ſheet, raiſe the tack, and gather aft the weather ſheet, as the lee one is eaſed off; ſo that, when the ſhip is right before the wind, the yards will be exactly ſquare, or perpendicular to the keel. Then ſhift over the jib and ſtay-ſail ſheets; and the ſhip continuing her evolution, haul on board the fore and main tacks, and trim all ſharp fore and aft, remembering to haul aft the mizen and mizen ſtay-ſail ſheets as ſoon as they will take the right way, or when the ſhip's ſtern has a little paſſed the direction of the wind. When the wind is on the beam, right the helm, to moderate the great velocity with which the ſhip comes too; the ſails being trimmed, ſtand on by the wind.

DEMONSTRATION.

DEMONSTRATION.

THE main-ſail and mizen are hauled up, and the mizen top-ſail ſhivered, in order to favour and facilitate the evolution (nn. 40. & 41). The main-ſail, however, might be excepted from this rule, by letting go the main-ſheet (n. 49.), and manœuvering it like the main top-ſail. The helm is put a-weather, becauſe, in that ſituation, the rudder (n. 50.) cauſes the ſhip to fall off, or yield to the impulſe of the wind, by impelling the after part of the ſhip to windward with ſo much the more velocity as the power of the head ſails exceeds that of thoſe abaft (n. 47), and as, the rapidity of ſailing increaſing, the effect of the helm augments in the ſame proportion. The ſails are trimmed to the direction of the wind, as the ſhip veers, to increaſe her head-way, and of courſe the power of the rudder (n. 58.); which, in great evolutions, is the chief mover, and principal agent of the movement of the ſhip. So that, its effects being augmented, the ſhip's circular motion is of courſe accelerated in the ſame ratio; and, if the wind be well followed, every ſail will be found properly trimmed when the evolution is finiſhed. It follows alſo that, ſince the ſails muſt be kept in a proper ſituation with reſpect to the wind, except the mizen top-ſail, which, from its ſituation on the after extremity of the ſhip, would retard her veering; the fore ſheet muſt be eaſed off to lee-ward, and gathered aft to windward, but in proportion as the ſhip falls off. It is alſo evident, for the ſame reaſon, that the bow-lines muſt not be ſtarted, till the ſhip begins to veer. When the wind is right aft, the jib and ſtay-ſail ſheets, which are then becalmed by the ſquare ſails, are ſhifted, becauſe the ſhip coming to the wind, they are ready trimmed, and are thereby highly ſerviceable in keeping her under command.

The mizen is hauled out as ſoon as the ſhip's ſtern has paſſed the direction of the wind, to accelerate her coming to (n. 40.); and the ſails fore and aft ought to be trimmed ſharp at the ſame moment, in order to keep to the wind without loſing any time. For the above-mentioned reaſons is the main tack got on board, and the ſheet aft, when the wind is on the quarter. *Q. E. D.*

ARTICLE II.

PROBLEM II.

To box-haul a ſhip, or the ſecond method of veering.

SOLUTION.

In the performance of this evolution, the moſt rapid execution is eſſential. It is done by briſkly, and at the ſame inſtant, hauling up both the main-ſail and the mizen; ſhivering the main and mizen top-ſails; putting the helm hard a-lee; raiſing the fore tack; letting go the head bowlines, and bracing about the head yards ſharp the other way; and letting the jib and ſtay-ſail ſheets go in the ſame inſtant. When the ſhip has fallen off 90°, fill the after ſails by bracing them ſquare, in order to give the ſhip a little way, and to help her (with the rudder, the ſituation of which muſt be changed) to double the point where all the ſails ſhiver; and, when the wind is aft, you will manœuver for the reſt of the evolution as in the firſt problem of this Chapter.

OBSERVATION.

If the circular motion of the ſhip, after ſhe has fallen off 90°, ſhould be ſtill ſufficiently rapid, the filling of the after ſails, to give the ſhip head-way, may be diſpenſed with; becauſe ſhe continues to turn by the effect of her helm, which muſt not be ſhifted (n. 58), ſince

ſince the veſſel ſtill continues her ſtern-way. Therefore, after having veered a few degrees more, the wind will fill all the ſails, and the ſhip, conſequently, will have head-way (nn. 35. & 43). Then the ſituation of the rudder muſt be changed (n. 50.), to bring her before the wind; and finiſh the evolution by manœuvering as before.

DEMONSTRATION.

I SAY this manœuvre ought to be performed with the utmoſt promptitude, becauſe it is never practiſed but in critical ſituations; ſuch, for example, as finding the ſhip unexpectedly cloſe to the land, or being under neceſſity to act in preſence of an enemy; or, again, becauſe every thing acts together and at the ſame time, or becauſe the ſhip miſſes ſtays.

THE reaſons for hauling up the main and the mizen ſails, and ſhivering the mizen top-ſail, having been given before, we have only to add, that the reaſon why the main top-ſail is ſhivered, is, that if it were kept full, it would bring the ſhip to the wind (n. 41.), by ſhooting her a-head, ſo that ſhe would almoſt be laid-to. If this ſail were braced a-back, more than perfectly ſquare or perpendicular to the keel, it would ſtill keep the ſhip to the wind, ſince it would be braced the ſame way with the head ſails. Therefore, it would impel the after part of the ſhip to leeward (n. 44), and act in conſequence againſt the power of the head ſails, which ought to cauſe the ſhip to veer rapidly, becauſe they receive the wind on their anterior ſurfaces (n. 37. & 38.) with a very great fine of incidence. Whence it muſt be concluded, that it is abſolutely neceſſary to keep the after ſails ſhivering till the ſhip has fallen off 90°, or thereabouts; becauſe, then, all the ſails are trimmed and ſhivering in the ſame direction, ſince the head ſails were ſuddenly braced ſharp a-back in the beginning of the evolution to promote the ſhip's veering; and the after ſails have alſo been changed at

the ſame time, by bracing them by little and little to the wind, to keep them ſhivering, as the ſhip falls off. So that, if the ſails have been well manœuvered, they will all be found ſhivering at the ſame time; and, in this ſituation, they no longer act on the ſhip, which will not double this point by the ſole effect of the helm, which was put hard a-lee in the beginning of the evolution, to heave up in the wind, with all poſſible expedition, the ſhip, which, ſoon after getting ſtern-way, falls off rapidly, both by the effect of her ſails, and by that of her rudder, which is well diſpoſed, it is true, for this movement (n. 58), but has not always ſufficient force to cauſe the ſhip to double the point where all her ſails ſhiver, becauſe the wind, being then on her quarter, acts on the whole machine, to ſend her a-head; ſo that, if one ceaſed manœuvering here for a moment, the ſhip would be motionleſs for a time, having loſt her ſtern-way. Now, to put her again in action, and prevent her from driving more than is neceſſary to leeward, fill the after ſails, as mentioned above, to give her head-way, in order that, by ſhifting the helm (n. 50.), the wind may be quickly brought aft.

The jib and ſtay-ſail ſheets are let go, becauſe they tend to draw the ſhip a-head (n. 31).

REMARK.

In a caſe abſolutely dangerous, or when it might be neceſſary to go a-ſtern and fall off ſtill more rapidly, the helm muſt be put alſo as before, and brace all the ſails a-back, having attention not to brace the after ſails more than ſquare or perpendicular to the keel, that they may not counteract the head ſails, which are braced ſharp a-back to pay the ſhip's head off; becauſe, the effect of the after-ſails, in this ſituation, is to impel the ſhip exactly abaft in the direction of the keel (n. 36.); which, with thoſe forward, contributes to give her freſh ſtern-way, in order to cauſe the ſhip to veer (n. 58.) with greater celerity, the helm being a-lee. The

jib

jib and ſtay-ſail ſheets before the main maſt being hauled flat over to windward, will aſſiſt the ſhip in falling off and going a-ſtern, (n. 31).

OBSERVATIONS.

When a ſhip ~~makes~~ builds a *chapel* *, that is to ſay, is taken a-back, by bad ſteerage or a ſhift of wind, ſhe will be brought to the ſame tack again, by inſtantly bracing ſharp round the head ſails, and keeping faſt the jib and ſtay-ſail ſheets. One muſt recollect, alſo, the after ſails are not to be touched (n. 45.) till the ſhip has ſufficiently fallen off; and, when that ſhall be the caſe, trim the ſails and ſtand on as before. The rudder is to be uſed, as occaſion may require, according to the 50th and 58th (nn.), whether the ſhip has head or ſtern way.

CHAPTER IV.

Of lying-to.

THE lying-to is the art of diſpoſing the ſails in ſuch a manner, as that, by counteracting each other, they render the ſhip as it were immoveable with reſpect to the diſpoſition ſhe has, by her form, to divide the fluid, at either extremity, with facility.

But,

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* A ſhip is ſaid to be chapelling, when ſhe is turned round in a light breeze of wind, being cloſe hauled, ſo as that ſhe will lie the ſame way ſhe did before. This is commonly occaſioned by the negligence of the ſteerſman, or by a ſudden change of the wind. Translat.

But, as this manœuvre is ſeldom practiſed but under the three top-ſails, it is indifferent whether the fore or main top-ſails be braced a-back, or kept full; becauſe, as theſe two ſails have ſurfaces *nearly* equal, which, by right, ſhould be *abſolutely* ſo, they have the ſame power either to ſtop the ſhip's way, or to cauſe her to run a-head; their poſition being ſuch, that when theſe two ſails act together, or one againſt the other, there is always one tending to pay the ſhip's head off, and the other to keep her to the wind (nn. 32, 37, 41, & 44). But there are alſo other conſiderations to be attended to, when neceſſity requires this manœuvre to be put in practice. For example, when you bring-to to the windward of a ſhip which you wiſh to avoid drifting near, the main top-ſail muſt be braced ſharp a-back, keeping the fore and mizen top-ſails full; becauſe the wind acts with a very ſmall ſine of incidence on a ſail when full cloſe hauled, in compariſon to that with which it ſtrikes it when braced ſharp a-back. So that the fore top-ſail, being full, draws the ſhip a-head, and its power of impelling the ſhip from the wind is ſtopped by the main and mizen top-ſails. She will of courſe not fall off much; nor will her lee-way be very conſiderable; for the ſhip is well kept to the wind, by the diſpoſition given to her ſails.

If occaſion requires to bring-to under the lee of a ſhip, the fore top-ſail ought to be braced ſharp a-back, the main and mizen top-ſails kept full, becauſe theſe two laſt-mentioned ſails tend to give the ſhip head-way, and keep her to the wind; beſides, they may be aſſiſted by the mizen, which is naturally diſpoſed to act againſt the falling off which the ſhip receives from the effect of the fore top-ſail, which is braced a-back, and maintains an equilibrium by counteracting the after ſails. So that, ſhould the ſhip to windward fall off violently, or drift too much, you are more ready to veer ſhort round, and avoid being boarded; becauſe the fore top-ſail being braced ſharp a-back, the impulſe of the wind on it is much greater

greater than if it were full; and is, as a ſail, well diſpoſed to veer ſuddenly, as ſoon as the power of the other ſails ſhall be ſuppreſſed.

ARTICLE I.

PROBLEM I.

To bring-to with the fore or main top-ſails a-back to the maſt, or filled.

SOLUTION.

To execute this manœuvre, the fore or main top-ſails muſt be braced ſharp a-back, and the lee bowline hauled up a little: the other two top-ſails trimmed ſharp; with the mizen hauled out, and the helm a-lee.

DEMONSTRATION.

It has already been demonſtrated, that if the fore or main top-ſail be braced ſharp a-back, while the other remains full by the wind, the ſhip ſtands as if it were immoveable, with reſpect to her velocity, in the direction of the keel; ſince one of theſe ſails prevents the effects of the other, whether to cauſe the ſhip to fall off, or to come to the wind; for, their actions are abſolutely contrary with reſpect to the center of gravity (n. 18.), and very nearly equal; therefore, in this ſituation, the ſhip can but drive to leeward, and will do it at the rate of half a league an hour for the utmoſt.

REMARKS.

If you bring-to with the fore top-ſail to the maſt, you may do it by bracing the head yards only ſquare, which otherwiſe is called perpendicular to the keel. Then, the wind will act obliquely on the

the ſail, and the ſhip will fall off but little, becauſe its effect is only in the direction of the keel from forward aft, and the ſails abaft keep the ſhip to. The main top-ſail may be manœuvered in the ſame manner, if you wiſh not to expoſe yourſelf much to the wind.

ARTICLE II.

PROBLEM II.

To bring-to with the three top-ſails a-back.

SOLUTION.

The jib and ſtay ſails being hauled down, brace ſharp round at once all the ſails you wiſh to lay a-back in hauling up the lee bow-lines, the better to expoſe the ſails to the action of the wind; haul out the mizen, and put the helm hard a-weather.

DEMONSTRATION.

The jib and all the ſtay ſails are hauled down, becauſe they are before the center of gravity (n. 31.); and the head ſails being braced ſharp a-back, have force enough (n. 37.) to balance the effect of thoſe abaft (n. 44.); which, being braced in the ſame manner, receive the wind with the ſame ſine of incidence as thoſe forward. But, as, in that ſituation, the head ſails have more power to cauſe the ſhip to fall off (n. 12.) than thoſe abaft (which are a little becalmed by thoſe forward) have to bring her to the wind, the mizen is hauled out (n. 40.), and the helm is put a-weather (n. 58.), becauſe the ſhip goes a-ſtern with all the top-ſails to the maſt. It is then proved, that, in this ſituation, the ſails, aſſiſted by the rudder, act the one againſt the other, and balance reciprocally their effects of ſpringing the luff and falling off; and, although the

the ſhip goes a-ſtern and drifts a great deal, ſhe is layed-to; becauſe, in that ſituation, ſhe yields but with great difficulty to the impulſe of her ſails, on account of the reſiſtance of the water (n. 5.) which oppoſes the very great ſurface of the bottom under the lee.

REMARKS.

WAS there any occaſion to wiſh to keep the mizen top-ſail full, it might be done with advantage; becauſe the effect of its acting againſt the other ſails is ſo inconſiderable, that it cannot admit of a compariſon, as its ſurface is hardly half that of the main top-ſail.

IF you wiſh to go a-ſtern without falling off, the ~~fore~~ head-ſails are to be laid ſquare only.

CHAPTER V.

ARTICLE I.

PROBLEM I.

To fill, when lying-to, with the fore top-ſail to the maſt.

SOLUTION.

TO fill, and ſtand on, when the fore top-ſail is braced ſharp a-back, you muſt brail up the mizen, hoiſt the jib and fore-top-maſt ſtay-ſail, ſhiver the main and mizen top-ſails; and, when the ſhip has fallen off 20° or 30°, fill the fore top-ſail, which was a-back before, and ſtand on.

DEMONSTRATION.

THE mizen is hauled up, that its effect of keeping the ſhip to the wind may ceaſe (n. 40). The jib and fore-top-maſt ſtay-ſails are hoiſted, to aid the ſhip in falling off (n. 31). The main and

mizen top-ſails are ſhivered, becauſe their effects are contrary (nn. 41. & 44.) to the movement expected from the ſhip. Therefore, every thing, which may cauſe her keeping to the wind, ceaſing to act, and every thing, which can promote her falling off, now operating, it follows ſhe muſt fall off with a celerity ſo much the greater, as the helm is ſtill a-lee (n. 58.), becauſe the ſhip goes a-ſtern, ſince her head-ſails are braced a-back, and her after-ſails ſo diſpoſed and ſhivering, that, when ſhe has fallen off ſufficiently, the head ſails fill, and you ſtand on directly.

ARTICLE II.

PROBLEM II.

To fill, when lying-to, with the main top-ſail to the maſt.

SOLUTION.

Brace ſharp and briſkly the fore top-ſail a-back; ſhiver the main and mizen top-ſails; hoiſt the jib and fore-top-maſt ſtay-ſails, and brail up the mizen, all at the ſame time; and, when the ſhip has fallen off 20° or 30°, fill the fore top-ſail, that the ſhip may ſtand on her courſe.

DEMONSTRATION.

The fore top-ſail is braced ſharp a-back, in order to cauſe the veſſel to fall off with greater promptitude, as then it receives a very ſtrong impulſion from the wind (n. 37.): as for the reſt of the demonſtration, it is the ſame as in the foregoing problem.

REMARKS.

If you are obliged to keep the wind on the ſame tack as that on which you are lying-to, you have only to right the helm, fill the top-ſail which is a-back, and trim it ſharp, to continue your courſe.

Another

ANOTHER method would be to trim the top-ſail which was to the maſt, in order to give the ſhip way through the water, and be able to tack, or run large, according as may be found neceſſary. But this method is very tedious, unleſs you mean to heave in ſtays, in which caſe it will be moſt expeditious.

WHEN you lie-to with the main top-ſail a-back, you may fill and continue your courſe by ſhivering it, and the mizen top-ſail, keeping the fore top-ſail full, righting the helm, and running up the jib and fore-top-maſt ſtay-ſail at the ſame time. As ſoon as the ſhip has fallen off enough to get head-way, fill the after-ſails, and keep the ſhip in the direction you mean to follow. It is eaſily ſeen that this method, though the moſt common, is not the moſt expeditious, when you have to veer conſiderably.

ARTICLE III.

PROBLEM III.

To fill, when lying-to with all the ſails to the maſt.

SOLUTION.

LET the mizen be brailed up, lay the after yards ſquare or perpendicular to the keel, and ſhift the helm a-lee. When the ſhip has fallen off ſufficiently to fill, by her movement, the after-ſails, thoſe forward are then to be braced about and trimmed full alſo, in order to ſtand on in the direction you wiſh to ſteer.

DEMONSTRATION.

THE mizen is brailed up, becauſe its effect is to keep the ſhip to the wind (n. 40). The after yards are braced perpendicular to the keel, becauſe, in that ſituation, they have no other effect than that of giving the ſhip ſtern-way (n. 36.), which cauſes her to fall off, ſince they increaſe her velocity in the laſt-mentioned direction,

the helm being a-lee ſo as to turn the ſtern to windward (n. 58). The head ſails are braced about and filled at the ſame time as the after ſails are ſo, that the ſhip may not be as it were laid-to, and that ſhe may get head-way to continue her courſe.

CHAPTER VI.

Of lying-to in a gale of wind.

TO lie-to, when it blows hard, is to keep as cloſe as poſſible to the wind, under one ſail only, well trimmed, with the helm laſhed a-lee as much as may be requiſite for the ſhip. And as ſhips commonly bring-to from the ſtreſs of contrary winds, which will not admit of carrying other ſails, care ought to be taken of lying-to under that which will leaſt ſtrain the ſhip; becauſe there are ſome ſhips which behave better under the fore-ſail than the main-ſail; others are more eaſy under the laſt-mentioned ſail; ſome are found to do very well under a mizen; and many veſſels lie-to beſt under a main ſtay-ſail.

LYING-TO under a fore-ſail is advantageous for veering (n. 32.) when you are well to windward; but it augments the lee-way, and is more ſubject than any other ſail to cauſe the ſea to break on board, on account of the ſhip's continual falling off: becauſe, in that movement, ſhe gathers way by yielding to the impulſe of the gale, and is afterwards recalled to the wind by the helm (n. 50): ſo that in the ſpringing of the luff ſhe goes up to and meets the wave which comes from to windward, and, as ſhe reſiſts it powerfully, that mutual ſhock cauſes it to riſe, and fall on board the ſhip.

LYING-TO under a main-ſail does not ſuffer the ſhip to fall off ſo eaſily as the laſt-mentioned mode, becauſe its effect paſſes abaft the center of gravity of the ſhip (n. 41); but it keeps the ſhip more to the wind, and conſequently occaſions leſs lee-way.

UNDER

UNDER the mizen, ſhips keep better to the wind, than under any other ſail, becauſe this ſail is farther abaft the center of gravity (n. 40.) than any of the reſt; conſequently ought to keep the veſſel from drifting more than any of the others; but is inconvenient, ſhould you have occaſion to veer ſuddenly.

UNDER the main ſtay-ſail, a ſhip will not make ſo much lee-way as under a fore-ſail, becauſe its effort paſſes very near the center of gravity of the veſſel; but it will however cauſe her to drift more (n. 31.) than the main-ſail (n. 41.): ſo that this mode of lying-to is a mean between the two others, and is preferable when it blows ſtrong enough for that ſail to ſupport the rolling of the ſhip. It ought farther to be preferred, becauſe the ſhip will veer under that ſail, the action of which paſſes at a ſmall diſtance from the center of gravity (n. 31.), and the power of which ſurpaſſes the reſiſtance which all ſhips meet from the fluid under their lee; a reſiſtance which always gives them a great inclination to fly up in the wind, when it blows hard, or when under a heavy preſs of ſail.

ALL theſe different modes of lying-to have, as we have obſerved, their different and peculiar faults: that is the reaſon why, for my part, I prefer being under the fore ſtay-ſail, the main ſtay-ſail, and mizen ſtay-ſail; becauſe, under theſe ſails, the ſhip will ſteer (n. 46.), and is in a better ſituation for veering than under any other ſail; for you have only to haul down your mizen ſtay-ſail, and put the helm a-weather; the two other ſails being before the center of gravity (nn. 30. & 31.) of the ſhip, will cauſe her to fall off, ſhe will then ſoon gather way, and ſteer eaſily.

SHOULD the gale continue very hard, and one of theſe ſtay-ſails be blown away, the loſs is not of a very great conſequence, as you have the courſes, in caſe of an emergency, ready to ſet; whereas it is not always in your power to replace any one of theſe, when you come to looſe them, and you find yourſelf much embarraſſed, particularly in thoſe moſt violent and ſudden ſhifts of wind, when

ſhips

ſhips generally looſe every rag of canvas they have ſet*. So that to lie-to under the three ſails above-mentioned, to me appears preferable in every reſpect†, whether you wiſh to veer, or keep your wind: becauſe, if you find the ſhip does not ſufficiently keep the wind, you may haul out the mizen (n. 40.), *(which by this time is ſuppoſed to be balanced,)* or take in the fore ſtay-ſail (n. 31.), or even the main ſtay-ſail. One of theſe ſtay-ſails, before the center of gravity of the ſhip, is ſufficient to make her veer as ſoon as the after ones are ſuppreſſed. There are beſides theſe other conſiderations ſtill for ſo doing. The ſhip will carry ſail better; becauſe, as the center of effort of thoſe on her is very low, ſhe drifts leſs, holds a better wind, and goes faſter through the water (nn. 25. & 46.); and theſe three or four ſails are ſituated in ſuch a manner as to give the whole body of the ſhip play; which will ſtrain her leſs than when under one ſingle ſail, which cannot by itſelf work it from aft forward.

DEMONSTRATION.

THE object of lying-to being to keep to windward as much as poſſible, when foul winds, and tempeſtuous weather, prevent you from purſuing your courſe, it follows, as much ſail ſhould be carried, as is conſiſtent with ſafety; and, as you are often unable to ſet more than one ſail, it is trimmed ſharp, that the ſhip may keep her wind as much as poſſible. It is alſo for this reaſon the helm is at the ſame time put a-lee; becauſe the ſhip having but very little way (n. 46.), ſhe falls off, in yielding from time to time to the impulſe of the wind, which acts on her without ceaſing; but,

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* IF the fate of the Ramilies, when lying-to under a main-ſail, be recollected, thoſe who looſed theſe ſails only may deem themſelves extremely fortunate.

† SHOULD the ſea run too high for the lower ſtay-ſails to keep the ſhip ſteady, a cloſe-reefed main-top-ſail (particularly if it has four reefs in it to come cloſe down to the cap) will be found to anſwer the purpoſe admirably.

but, as ſoon as ſhe has fallen off, the veſſel is brought to again by the effect of the rudder (n. 50), which cannot fail acting upon her if the water has but ever ſo little power upon it.

THE ſame thing happens in lying-to under the three ſtay-ſails (though the ſhip makes more headway under any other ſail), becauſe the effect of theſe ſails is better diſtributed (n. 46.) than when there is but one of them only ſet; notwithſtanding they have not power enough to procure the ſhip much velocity, nor to make her ſteer properly; the helm is therefore put a-lee as in lying-to under any other ſail. There are fine ſailing ſhips, which ſteer very well under theſe ſails, which muſt be very attentively taken notice of: for, it is always more advantageous to keep the ſhip under way and lively, than to let her lay motionleſs at the mercy of the wind and waves.

WHEN the wind is ſo violent that no ſail can be carried, you lie-to a-trys; that is to ſay, under bare poles and ropes, which ſerve as and inſtead of ſails, and laſh the helm a-lee as uſual*.

PROBLEM.

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* THERE are hurricanes in the Weſt-Indies which are ſo dreadful, and which have cauſed ſuch damages to ſhips, that I think it is not improper to ſay a word of them here, eſpecially as I am of opinion that, with a little more caution, care, and ſkill, in the officers who had the manœuvering of them, a great many accidents might have been avoided, *nay, even prevented*, by obſerving ſome of the precepts above delivered by the learned Author of the preſent Work, and ſome of our beſt ſhips could have been ſaved and brought back to Europe, which have been totally loſt in thoſe latitudes.

IT is in the months of Auguſt, September, and October, thoſe moſt dreadful ſtorms are always to be expected. And, notwithſtanding this previous and general knowledge, which they, who frequent thoſe ſeas, have of what they are to expect, at ſuch a ſeaſon, I have known a ſhip attacked by one of thoſe hurricanes which hardly knew where to find a grating or tarpaulin for the hatches; by which neglect the ſhip was very near being ſent to the bottom, had it not been for the utmoſt exertions of pumping and baling, and a relief ſtill more efficacious, I mean the main, quarter-deck, and forecaſtle guns, as well as the main and mizen maſts, which went naturally

PROBLEM.

To veer ſhip when lying-to under a main-ſail.

SOLUTION.

ADVANTAGE muſt be taken of the ſhip's falling off to put the helm a-weather, and eaſe away the main ſheet roundly; and when the

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naturally over the ſide at that time. Had it not been, indeed, for theſe lucky circumſtances, the ſhip muſt infallibly have foundered. It is very clear to me that a number of our veſſels have ſuffered from nothing but a want of attention to the important point of the hurricanes ſo common in thoſe ſeas. For, the examples I have ſeen of that, are ſufficient to convince people more incredulous than I am, that, with ſkill, attention, and proper proviſions to guard againſt thoſe accidents, they might ſave the ſhip from being loſt. As a proof, I will quote the very ſame ſhip, which, *ſtrange to tell!* the year following, was, if poſſible, ſtill worſe provided for than the firſt time againſt the hurricane by which ſhe was attacked. And, to illuſtrate this matter, I will attempt to give here a ſhort account of twelve hours proceedings.

THE ſhip riding in Bluefields, in the South-Weſt of the iſland of Jamaica, with one third of a cable on the ſmall bower, and top-gallant yard acroſs, it came on to blow between the hours of three and four in the afternoon; and it gradually freſhened more and more till ſix, when it blew very hard. The ſteps taken to rid the ſhip were ſingular, and ſuch as, I dare ſay, a ſeaman would little dream of. Inſtead of making the neceſſary preparations uſual in blowing weather, and giving the ſhip more cable, another anchor was let go under foot (top-gallant yards ſtill acroſs). Then, at ſeven, ſhe parted the ſmall bower, took the beſt bower on her ſhoulder, and drove off the bank. Now, it was thought expedient to get down the top-gallant yards, which was performed with ſome difficulty, as the ſhip was then lying along ſo that the main-deck guns almoſt touched the water. The top-gallant maſts were next attempted, but too late; for, the gale raged at that moment ſo violently that no man could go aloft. The beſt bower anchor was heaved up; but, for want of being able to ſecure it properly, it was ſoon found neceſſary to cut the cable and let it go. All the neceſſaries for battening down the hatches were now, as the year before, to be looked for. The gratings were however, after a deal of trouble, muſtered up from the different parts of the ſhip to their reſpective places, and the hatches were battened down juſt as might have been expected from ſuch a ſituation, which was very unfit for that operation; ſince it required the whole and conſtant effort of the pumps to free the ſhip of the water which was pouring down through the hatchways.

But

the ſhip has fallen off about 30°, the bowline is to be let go, and the weather brace rounded in, taking care to keep the ſail full. When

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But, what elſe could be expected in ſuch a circumſtance? This ſo eſſential piece of ſervice had never been thought of till the ſhip was almoſt on her beam ends from the violence of the wind; and much indeed cannot be expected from the execution of the carpenter's hammer, when he himſelf, amidſt ſuch a dreadful warring of the elements, and the horrors of a night as dark as Erebus, is deprived of all the faculties of his ſoul by fear, and of his body by the rolling of the ſhip; for no one can ſtand faſt.

By this time, the hurricane was become dreadful beyond conception; its action was like that of fire: every thing diſappeared which oppoſed it; and the maſts, notwithſtanding their ſize and ſolidity, powerfully ſupported by the rigging, were no longer able to reſiſt its unremitting fury. The mizen maſt went firſt; in about two minutes afterwards the main maſt followed; and, inſtantly after, went the fore-maſt and bowſprit. This moſt diſtreſsful ſituation of the ſhip is undoubtedly more eaſy to conceive than to deſcribe: terror and aſtoniſhment, for an inſtant, ſeized every mind, oppreſſed every heart. But, this ſtupor was only momentary, and was ſoon overcome by that intrepidity and indifference to danger which ſo eminently characteriſes Britiſh ſeamen; and the wreck, conſidering the tremendous concurrence of the winds and waves againſt ſuch an operation, was however cleared away with wonderful alacrity.

About this time, the wind chopped round to the Southward, and raiſed a moſt dreadful ſea. The tiller was now carried away; but its place was ſoon ſupplied by the ſmall one in the cabin. The ſhip continued to drift all night, with the pumps inceſſantly going. At the break of day, the land was ſeen right under the lee, about two miles diſtance. The aſpect of this land was however far from being pleaſant, as it was high ſteep rocks, and there were no ſoundings near them. Of ſaving the ſhip, hardly a ray of hope now remained; for, the wind, though much abated, ſtill continued to blow with great violence dead on ſhore. The fore-maſt, on which was hoiſted a mizen top-gallant ſail, was gone about twelve feet above deck. The ſtumps of the main and mizen maſts were about the ſame height; upon which, while employed to get ſails ſet, the wind providentially ſhifted from South to Eaſt, which, co-operating with a moſt rapid Weſterly current running on ſhore, cleared the ſhip of the rocks, by making her paſs them within about two cables lengths.

Now, notwithſtanding the dreadful violence of thoſe hurricanes, let us examine whether, by proper precautions, their tremendous effects might not be greatly pal-

When the ſhip is before the wind, get on board the main tack, and right the helm, to moderate her coming-to, and trim all ſharp in order to keep her to.

IF,

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liated. For example, let us ſee what ſhould have been done before the gale was become outrageous, for there was time ſufficient to do a great deal of buſineſs, as it came but ſlow, and gradually. Firſt, on finding the approach of this dreadful tempeſt, inſtead of driving to ſea with top-gallant yards acroſs, the top-ſail yards ſhould have been taken down upon deck, and the top-maſts lowered cloſe down, and their heels well ſecured. The rigging ſhould have been made ſnug and firm on the tops; the ſprit-ſail yard and jib-boom taken in; and the croſs-jack and mizen yards lowered down. Good down-haul tackles ſhould have been fixed to the fore and main yards, to get them down and ſecured cloſe to the gunwale as ſoon as they are found of no further uſe than to ſtrain the maſts. The ſhrouds alſo ſhould have been well ſwifted if ſlack, the booms and boats well frapped, the hatchways well ſecured, the lower-deck guns double breeched, coined, and ſecurely muzzle-laſhed. The ſpare tiller ſhould have been at hand, with the relieving tackles ready in the gun-room, in caſe of accident to the tiller rope. The fore locks of the main deck, forecaſtle, and quarter-deck guns ſhould have been looſened, ready for their being thrown overboard, in caſe the hurricane ſhould continue any conſiderable time, and by its violence much weaken the ſhip; as was the caſe, to a moſt perilous degree, with his Majeſty's ſhip HECTOR, in the violent hurricane of the year 1780; when, in order to prevent her foundering, ſhe was obliged to throw every gun ſhe had into the ſea.

EVERY thing being now thus in order, and quite ready or prepared againſt any accident which may happen, if you think, from the appearance of the weather, you have time to lift your anchor, let it be done, as it may be of eſſential ſervice before the gale is over; if not, cut and run, for fear, by a ſhift of wind, you ſhould get dangerouſly land-locked.

THE lower yards are ſtill to be kept aloft, that the courſes may be ſet if the force of the wind will admit, to enable you with all poſſible expedition to get clear of the land. Then, when you find you have got a ſufficient offing, the yards are to be lowered down and ſecured to the gunwale.

BUT, ſhould the gale be too far advanced to allow the courſes to be ſet, the ſhip may run off before the wind under the lower ſtay-ſails, as the ſea is yet (comparatively ſpeaking) tolerably ſmooth, ſince the wind is off the land. And, when the gale becomes too powerful for the ſtay-ſails, they are to be hauled down, and ſecurely ſtowed, to prevent their being blown away. Then the ſhip, under her bare poles, will

run

IF, in the beginning of the evolution, the ſhip is difficult to veer, the fore-ſtay-ſail may be hoiſted and the ſheets hauled well aft: but it is to be hauled down as ſoon as the ſhip is before the wind.

DEMONSTRATION.

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run before the wind with a ſufficient rapidity to get at the neceſſary diſtance from the ſhore. That point being obtained, laſh the helm a-lee, and wait for the event.

WHAT is here recommended to be done, in ſtriking maſts and yards, and carrying ſails off ſhore, muſt be conſidered as a mere intimating of what might have been executed on board the ſhip firſt mentioned, conſidering the ſituation of the land and the progreſs of the gale; for, we are well appriſed that different times and different ſituations render different manœuvres neceſſary.

ONE thing, however, is brought by experience to a very great point of certainty; *viz.* that the weight aloft muſt be very much diminiſhed if you want to ſave the lower maſts: that is to ſay, that the top maſts muſt be lowered down as well as the lower and top-ſail yards. If this cannot be done, they muſt, if poſſible, be cut away, or the loſs of the lower maſts is unavoidable; a weighty conſideration, as, (not to mention the riſk the ſhip runs from a total inability to manœuver, while the violent ſwell, which always is the conſequence of thoſe tempeſts, continues,) if we conſider again how often the extreme motion of the ſhip renders all attempts to get up the jury-maſts abortive, it will appear moſt evident that the preſervation of the lower maſts is of the higheſt conſequence abroad.

GETTING the lower yards down and ſecured to the gunwale is certainly in the power of every ſhip, if it be, but in proper time, put in execution, and eſpecially as (which is another conſideration of the higheſt importance) a line of battle ſhip's main-yard very frequently cannot, in a remote country, be purchaſed, and even granting it might be had, ſuch a purchaſe cannot fail being attended with loſs of time and delay; and that is always prejudicial to the ſervice.

IN order ſtill farther to evince the indiſpenſable neceſſity of relieving the lower maſts, let us now recollect how in the year 1780 there was not a veſſel, which came within the ſweep of the hurricane, but was diſmaſted; among which were reckoned eight or nine ſail of the line*; a proof that the largeſt ſhips are not the more able to ſtand its fury. The following year, the very ſame thing happened again; and, out of three men of war which were at ſea on that ſtation, one was abſolutely loſt, and the other two, after being diſmaſted, were ſaved but by the moſt miraculous interpoſition of Providence†.

HAD

* Admiral Rowley's ſquadron.

† His Majeſty's ſhips ULYSSES and SOUTHAMPTON. The PELICAN was loſt on *Morant's Keys* on the ſame night, being the 1ſt of Auguſt, 1781.

DEMONSTRATION.

THE reaſon why, to execute this evolution, an opportunity muſt be taken of the ſhip falling off, is becauſe that motion of the ſhip gives her way, and makes her of courſe better diſpoſed to gather way. For that very ſame reaſon alſo the helm is then put a-weather (nn. 50. 58.), and the main ſheet eaſed off roundly (n. 49.), that that part only of the ſail which is before the center of gravity of the ſhip may be left to act. The main bowline is kept faſt till the ſhip has fallen off 30° at leaſt, and then let go directly, becauſe the wind is then more eaſily kept in the ſail, the velocity of the ſhip increaſed, and conſequently the power of the helm (n. 58.) and the movement of evolution are alſo accelerated (nn. 16. 17. 18.). By hauling in the weather brace, you follow the wind with the ſail;

HAD the precautions, I have juſt before mentioned, been taken, I cannot help thinking the maſts might all have been preſerved, and the ſhip and her crew leſs expoſed to a lee-ſhore, which was like to have proved fatal to the whole.

THE ſea being then covered with wrecks, againſt which ſhips are very apt to run in the night, there wants but ſuch an accident happening, joined with the violent motion of the ſhip, to make a butt-end ſtart; and if, in ſuch a caſe, a quick remedy is not found, it is clear that, in ſpite of all the pumps, the conſequences muſt be fatal. On this occaſion, I muſt here mention what (as I have been informed) anſwered once moſt admirably the purpoſe of remedying ſuch an accident.—— A RECEIPT.—Take a ſtudding ſail, or ſome ſuch ſmall ſail; then take a quantity of oakum, horſe-hair and wool, if they can be got, which chop ſmall and well mix together: when done, make a compound of it with hay or ſtraw, cut very fine, and mixed with lime and any dung or filth you may happen to have on board: then ſtick this in handfuls to the ſail as lightly as poſſible. The ſail being thus prepared, haul it under the ſhip's bottom with ropes ſo faſtened to the ſail as to keep it extended. The ſuction which promotes the rapid entrance of the fluid into the leak will draw the compoſition from the ſurface of the ſail and force it into the fracture, in ſuch a quantity as, if not intirely capable to ſtop it, will generally however keep out ſo much of the water as to render the danger very trifling.

N. B. This Note is not in the Original, nor is it the Tranſlator's own production; but has been furniſhed by an Engliſh Officer diſtinguiſhed for his nautical abilities.

ſail; and, when the wind is right aft, ~~the yard~~, that ſail will, by that means, be found perpendicular to the keel, or, in other words, ſquare. To trim it, you have but to eaſe off the brace and bring the tack on the ſame board as you take the wind; an operation for which you have full time ſufficient, as, by righting the helm, you moderate the velocity with which the ſhip flies to the wind, ſince by that action the effect of the rudder is totally ſuppreſſed.

REMARKS.

THERE is another method of veering ſhip under a main-ſail, which may eaſily be practiſed. You make faſt a three or four inch rope *(in proportion to the ſize of the veſſel)* to the ſlings of the main yard; and, when the ſhip comes-to, ſo as to ſhiver the main-ſail, bring it down before the ſail to the top-ſail-ſheet bits, and let it be hauled well taught and belayed. Then, as ſoon as ſhe falls off, the helm is to be put a-weather, as above mentioned, and the main ſheet let go. By that means the lee part of the ſail no longer has any power to keep the ſhip to the wind, and the weather part acting before the center of gravity will cauſe her to veer faſter than by the firſt manœuvre; though, in general, that firſt manœuvre will hardly once miſs to anſwer the purpoſe.

To veer a ſhip under a hull or her bare poles, the fore-ſtay-ſail muſt, if circumſtances will allow it, be hoiſted (n. 31.). But, if that cannot be done, the head yards are to be braced up as ſharp as poſſible, and thoſe abaft pointed to the wind, or parallel to its direction. Then, if the ſhip veers, ſhe will ſteer under the maſts and ropes only. A certain quantity of ſeamen, ſent up and placed cloſe to each other in the fore ſhrouds to windward, will, in a caſe of this kind, be found alſo of very great ſervice.

CHAPTER VII.

ARTICLE I.

PROBLEM I.

Of ſounding in fair weather.

SOLUTION.

IF cloſe hauled, brail up the mizen and mizen ſtay-ſail, let fly the main ſheet ſo as to have the ſail ſhiver, put the helm a-lee, and back the mizen top-ſail by bracing it perpendicular to the keel. The head-ſails, as well as the jib and ſtay-ſails, are to be kept in their firſt ſituation; one muſt only have care to haul taught and belay the lee braces; and, as ſoon as the ſhip has very nearly loſt her headway, though continuing ſtill to come to the wind, you catch that moment to heave the lead, and haul it in again with all poſſible diſpatch as ſoon as you have touched the ground. Then, you may fill and ſtand on again by hauling aft the main ſheet; trimming the mizen top-ſail, and righting the helm.

DEMONSTRATION.

THE mizen and mizen ſtay-ſail are brailed up, becauſe their effect to bring the ſhip to the wind would be too powerful (n. 40). It is alſo for the ſame reaſons the main ſheet is let go (n. 41.), though there is another beſides this which is that it deſtroys the equilibrium which exiſted between the ſails forward and the ſails aft (nn. 46. 49.); whence the rapidity of ſailing is diminiſhed, as well as the effect of the helm, which acted (n. 50.) to bring the ſhip to the wind, while at the ſame time it oppoſes her velocity (n. 59). The mizen top-ſail is braced a-back, and perpendicular to the keel, to impel the ſhip a-ſtern in the direction of her length (n. 36.); ſo that her headway being now much diminiſhed by the new diſpoſi-

tion

tion given to the forces which are to produce it, the ſhip, by the effect of the rudder, ranges to the wind ſo far as to cauſe to ſhake the main top-ſail and the ſails on the foremaſt, which, to that very moment, had acted to keep up the celerity of ſailing (nn. 32. 41). But, as the effect of the rudder is very faint, ſince the velocity of the ſhip is greatly diminiſhed (n. 58.), when the ſails have loſt their action, it follows the ſhip muſt ſtop, and is not able to come ſufficiently to the wind, to bring her about, becauſe the jib's and ſtay-ſail's ſheets being hauled aft, oppoſe the effect of the helm (Art. 31.); ſo that ſhe reſts as it were motionleſs for an inſtant, which muſt be ſeized to throw the lead with the greateſt diſpatch; becauſe, ſhould the ſhip come to fall off by the effect of her jib and ſtay-ſail, which are the only ones in action, the other ſails might ſuddenly fill and give her headway, which would prevent you from getting ſoundings, were you too dilatory in throwing the lead. Whether you do, or do not, find any bottom at all, in hauling in your line as faſt as poſſible, you muſt ſeize the opportunity of the ſhip falling off, to fill and ſtand on again.

Should the ſhip, in ſpite of the diſpoſition here given to her ſails, come head to wind (which could not happen but from her having preſerved ſome velocity), the helm muſt continue to be kept a-lee, but the head-ſails ſhould quickly be laid ſquare or perpendicular to the keel, and the jib and ſtay ſails hauled down; then the ſhip will ſoon after be found to veer.

REMARKS.

In going large, you have only to put the helm a-lee, without forgetting to brail the mizen up, and to belay the lee braces quite taught, to prevent the yards having too much play when the ſails are ſhivering. It is impoſſible ever to tack in this ſituation, as the jib and head ſails are always in action (n. 31.); and the ſquare ſails ſoon coming to ſhake, on account of their ſheets not being tacked, they

they loſe all their power: therefore, nothing working for the ſteerage way, the ſhip is ſoon at a ſtand.

ARTICLE II.

Another method, preferable to the former.

If the depth of water were conſiderable, as 80, 100, or 200 fathoms, and you wiſh to ſound ſmartly and with exactneſs, you had only to brace the head-ſails perpendicular to the keel, when going large, haul down the jib and ſtay ſail, without ſtirring the after-ſails, and put the helm a-lee; and, while the ſhip has ſtill a little headway, you heave the lead from the ſame place you haul it in; that lead will go firſt a little a-ſtern; but the ſhip being head to wind, will herſelf go a-ſtern likewiſe right upon the line which, by its own proper gravity, happens then to be juſt a-peek: and, as the helm is a-lee, the ſhip eaſily veers. But, if you wiſh to keep her toolonger, you have only to right the helm, and haul the mizen out, to prevent the ſhip's falling off.

If you have ſtudding ſails ſet, they muſt be hauled down, particularly the lower ones; becauſe, ſhould the wind take them a-back, their power on the boom might bring the ſhip round entirely: for, they act on a lever without the ſhip, the fulcrum of which is on the outſide of the veſſel before the center of gravity. If, however, the helm is continued a-lee till the ſhip falls off, ſhe will not come about, becauſe then the veſſel goes a-ſtern with great velocity, and the rudder acts powerfully to make her veer; but the fact is, that the ſhip will go a great deal ſtern-way, and continue ſo much longer.

If cloſe hauled, or a very little from the wind, the helm is to be put a-lee; and, the inſtant the ſails are taken a-back, the head-ſails are to be filled by bracing them briſkly perpendicular to the keel, without waiting for the wind being right a-head; then, a little before the ſhip has loſt her way, you heave the lead from the

ſame

ſame place you haul it in; and as for the reſt you manœuver as before mentioned.

CHAPTER VIII.

On chaſing.

THAT a ſhip might chaſe another, ſhe ought to have the advantage of ſailing. We ſhall therefore always ſuppoſe that the chaſer ſails better than the veſſel chaſed; becauſe, were the ſhip chaſed as good a ſailer as the chaſer, ſhe never could come up with her, if they manœuvered equally and at the ſame time, however full of ſkill and ability the manœuvre of the chaſer might be. It is then uſeleſs to follow a ſhip over which you have not the ſuperiority in ſailing, unleſs you find, from the manœuvre of the chaſe, ſhe does not know how to take the benefit of her equality.

To know if your ſhip has any advantage in ſailing, you muſt get on the ſame tack, under the ſame ſails, and keep the ſame courſe with the veſſel you mean to chaſe, and ſet her exactly with a compaſs. If you ſail beſt, the chaſe will ſoon be drawn a point more aft; but, if ſhe has the advantage, you will in a ſhort time bring her a point farther forward than the firſt bearing: if you ſail equally, ſhe will remain on the point you ſet her at firſt, ſuppoſing you keep the ſame courſe*.

ARTICLE

* THIS method, it is true, will ſhew the difference of velocity between two ſhips under certain ſails; but, though the chaſe may have the advantage under a certain particularly-diſpoſed portion of canvaſs, ſhe may not have the ſame ſuperiority with all ſails ſet. For, it is well known that ſome ſhips ſail (within a very little difference) as well under their three top-ſails, as with all the ſurface they can expoſe to the action of the wind; while the celerity of others will be multiplied two or three times, and frequently more. Without trying this experiment, ſail ought therefore, in my opinion, to be made inſtantly, and with the greateſt celerity poſſible, on diſcovering any ſtrange veſſel.

ARTICLE I.

PROBLEM.

To chaſe a ſhip to windward, and the ſhorteſt method of joining her.

SOLUTION.

When the chaſer finds himſelf to leeward of the veſſel he means to purſue, he ought to continue on the ſame tack as when the enemy was firſt perceived, till he brings her to bear exactly perpendicular to his courſe (if he has not however already paſſed that point): then tack, and continue the ſecond board till he again brings the chaſe, perpendicular to the direction on which he is ſtanding by the wind (or on his beam); or he muſt then heave about again; and always continuing the ſame manœuvre, by tacking every time he brings the chaſe perpendicular to his courſe on either board: and, by manœuvering in this manner, it is very certain that the chaſer will, by the ſuperiority only of his ſailing, join the other by the ſhorteſt method.

DEMONSTRATION.

Plate 3?

When the ſhip A (*fig.* 20.) chaſes the ſhip B, which is three leagues to windward, with one fourth advantage of ſailing, the chaſer is not to tack till he reaches the point C; becauſe he will then have the ſhip B, right on the beam at the point D. He is, then, to continue, on the tack C E, till he brings the chaſe perpendicular to his courſe at the point F. The ſhip A is to continue thus to manœuver every time ſhe brings the veſſel B right a-breaſt of her, whether the chaſe continues on the ſame tack or not; and thus the chaſer will join the other at H, ſo that ſhe will be able neither to change her courſe, nor recede from him.

You continue on the ſame tack as when the enemy was firſt ſeen, firſt in order not to loſe time, becauſe there is no fear of your bringing always the ſhip you are in chaſe of right on your beam, when

when you have a ſuperiority of ſailing, whatever may be the tack ſhe is on, provided you are always particularly careful not to paſs that point; for, if you did, there would not be a moment to loſe before you get on the other tack with all poſſible diſpatch.

The chaſer heaves about as ſoon as the veſſel he is in purſuit of is perpendicular to his courſe, or on the beam; becauſe ſhe is, at this time, at the ſhorteſt poſſible diſtance, if he chaſes on the ſame tack and ſteers the ſame courſe with the veſſel chaſed. If the chaſer runs on a different tack from the veſſel chaſed, he is ſtill to tack when the flying ſhip is on his beam, becauſe the diſtance is the leaſt poſſible between them on the different boards they hold. It is then evident the chaſer cannot better manœuvre than by tacking every time he brings the ſhip which is avoiding him perpendicular to his courſe, ſince he never paſſes the ſhorteſt diſtance poſſible between the two veſſels on the ſame or different boards they hold with reſpect to each other.

REMARKS.

In manœuvering, as we recommended above, you will be under the neceſſity of making a good many more boards than if you chaſed by the ordinary methods: but, this quantity of evolutions is always advantageous to the chaſer if the ſhip be well managed, and the ſails hauled ſmartly; then ſhe will always gain to windward, in ſtays, as is found from experience, when the above principles are adhered to, and the ſhip handled with ſufficient dexterity.

The manœuvre here preſcribed for the chaſing ſhip, is preferable to all others, not only becauſe it is the ſhorteſt, but becauſe you force the ſhip you are in chaſe of to fly from you cloſe upon a wind, in preſſing her more and more from the leeward, by never paſſing that point before mentioned, the ſhorteſt way poſſible between the two veſſels in plying to windward.

ARTICLE II.

Obſervations for the ſhip to windward, which is chaſed.

THE weather ſhip, which flies, will always be joined by the chaſer, notwithſtanding every manœuvre ſhe may execute, ſince it is granted ſhe does not go ſo well as the veſſel which purſues: it is therefore to her advantage conſtantly to keep the ſame courſe without loſing her time to heave about, as tacking cannot be ſo favourable to her as to her adverſary, whoſe ſailing is ſuperior.

IF the chaſer ſhould ſo little underſtand his profeſſion as to ſtand on a long way, and tack in the wake of the chaſe, the beſt thing ſhe can do is to heave in ſtays, and paſs to windward of him on the other tack (unleſs you ſuppoſe your veſſel would have a ſuperiority large); for if the chaſer perſiſts in tacking in the wake of the other ſhip, it is an unqueſtionable fact, that the chaſe will be very much prolonged.

I SHALL not here pretend to foreſee or give a detail of all ſituations in which a ſhip may be engaged in being chaſed, either by one or more veſſels; it would be an abſurdity in me to attempt it. I ſhall, therefore, content myſelf with offering ſome of theſe preſſing and general circumſtances, perſuaded the genius of an attentive officer will always ſuggeſt to himſelf the propereſt means of extricating his ſhip from the moſt difficult ſituations.

ARTICLE III.

PROBLEM.

To chaſe to leeward.

SOLUTION.

WHEN to windward of a veſſel you wiſh to chaſe, keep the ſhip away to cut her off; and, ſteering continually in the ſame direction, you come at laſt together at the point where the courſes run by the

two

two veſſels interſecting each other. This principle will be exactly executed by the chaſing ſhip, if, in the courſe ſhe has choſen, ſhe conſtantly keeps the veſſel ſhe is in chaſe of, on the ſame degree of the compaſs, as in the beginning of the chaſe. This principle is always the ſame in all the courſes the retreating ſhip ſteers; for, no overtaking can be executed but by keeping on a ſtrait line, which is the ſhorteſt poſſible which can be drawn between any two points.

DEMONSTRATION.

Should you take another courſe than that which keeps you in the ſame point of bearing you were in with reſpect to the veſſel purſued, at the beginning of the chaſe, you would miſs your aim, by being too far a-head or too far a-ſtern; that is to ſay, if the chaſer keeps his wind too cloſe, he will be too much a-head, and conſequently prolong the chaſe; and, if he keeps too much away, he will be too far a-ſtern. Theſe are the only two conſiderations to be made when this problem is to be executed; conſiderations eaſy to be obſerved, and corrected with an azimuth compaſs; becauſe, when you ſee that at the end of a certain time you bring the chaſe more aft, than her firſt point of bearing, it is evident you keep your wind too much; if, on the contrary, you draw her forward, it is a certain proof you keep too much away. Now, theſe inconveniencies are very eaſily remedied, by ſteering for the firſt caſe, ſo as to ſee that the ſhip chaſed is always kept exactly on the ſame degree of the compaſs; and, for the ſecond, you keep your wind a little more, till you ſee that you reſt always on the ſame point of bearing with reſpect to one another. Then, it is evident, you chaſe by the ſhorteſt and moſt certain method, ſince you reach the chaſe, in running on a ſtrait line.

REMARK.

As, in the caſe propoſed, the chaſer is to the windward of the ſhip chaſed, he veers as much as poſſible, and ſo as to keep the enemy always in the ſame point of bearing; but it might happen, that

that (by veering on the ſhip which flies) having found the poſition in which ſhe remains always on the ſame point of the compaſs, there could exiſt, by veering yet more, a poſition ſtill more advantageous than the firſt; becauſe your velocity may be increaſed, as much as you prolong the lines which you run over between the parallels of like bearing which you make in the courſe of the chaſe, to ſee if you do not ſwerve from the firſt.

ARTICLE IV.

Remarks for the ſhip which is chaſed.

When a ſhip, being to leeward of another veſſel which gives her chaſe, is obliged to fly, ſhe ought to run on the courſe that will carry her moſt immediately from the chaſer, and, in general, conſult which is her beſt ſituation with reſpect to the wind, that ſhe may move with the greateſt rapidity poſſible from the ſhip which purſues her. For, ſome veſſels have more advantage in going large than others; ſome with the wind right aft; and others, again, are to be found which go beſt cloſe hauled. So that attention ſhould be paid by the officer to the known qualities of his ſhip, in order to take the moſt advantageous and convenient directions capable to effect a retreat. However, it is near a certainty, that if the chaſe does not ſail at leaſt at an equal rate with the chaſer, whatever manœuvre ſhe may put in practice, ſhe will always be overtaken by a ſkilful chaſer adhering to principles. But, that there may be no room left for ſelf-reproach, every thing poſſible is however to be done to avoid ſinking under a ſuperior force, by taking advantage of every occurrence which offers: and, when you ſee the enemy will unavoidably come up with you, and that the event can no longer be deferred, heſitate not to attack with confidence and reſolution, and put to proper uſe the little force you have. Thus, it often happens that the heat of the enemy is cooled by ſuch an anticipated attack, and that intrepidity, ſupported with ſome favourable circumſtances, ſucceeds.

CHAPTER

CHAPTER IX.

Of Boarding.

BOARDING, in the ſenſe in which it ought to be underſtood, is at once an action of vigour, and the art of approaching the ſhip of an enemy ſo near, that you can eaſily (and in ſpite of him) heave on board your graplings, which are to be ready on the lower yard-arms, forecaſtle, gangways, &c, &c, for the purpoſe of being thrown into the enemy's ſhip by hand, as ſoon as along-ſide, in order to confine the veſſels together, and give the people an opportunity of getting on board, to carry the adverſe ſhip ſword in hand.

BUT, it muſt be conſidered that, between two ſhips which are engaged, it is generally the caſe that boarding is more advantageous to one than to the other; ſo that the one has an intereſt in endeavouring to board, and the other in avoiding being boarded. This difference of force, and way of thinking, renders the execution of this manœuvre difficult; whence it follows, that for both parties there are diſpoſitions which may be better concerted than others. This is what I mean to diſcuſs in the following Problems, which cannot be ſufficiently extended to take in all the many and various incidents inſeparable from ſituations of this kind. It will, therefore, be the buſineſs of the officers to avail themſelves of the advantages which occaſions and circumſtances will offer them naturally, or to procure them by their ſkill and the ſuperiority of their manœuvres.

ARTICLE I.

PROBLEM.

To board to windward, or avoid being boarded.

A SOLUTION DEMONSTRATED.

IF a ſhip wiſhes to board another which waits for her in keeping her wind under an eaſy ſail; or one which does not ſhorten ſail, but

but over which ſhe has the advantage of ſailing; ſhe muſt get on the weather quarter of the ſhip ſhe means to board, within half a piſtol ſhot. Then ſhe muſt begin the action, and continue it with a ſteady vivacity, to cover her manœuvre by the ſmoke of the cannon and muſquetry of both ſhips; then, under the cover of this cloud, let her make more ſail if ſhe has not way enough, in order to augment the velocity of the ſhip and the rapidity of her movements, that ſhe may with greater promptitude lay her enemy on board on the weather ſide, exactly a-breaſt, or a little abaft, no matter. This is very eaſily executed, by edging down unexpectedly upon her ſo as not to expoſe yourſelf however to be raked by the enemy's fire from to leeward. The ſhip boarded by this manœuvre can hardly ſuſpect that deſign but at the moment, or very little before, the grapnels will be on board of her. In this ſituation the boarded veſſel has but one doubtful expedient to try, in order to extricate herſelf from the perplexity in which ſhe is engaged, and which even will be of no ſervice if the boarder obſerves her well. For, the moment ſhe braces ſharp a-back her head-ſails, to cauſe the ſhip's falling off (n. 37.), and ſquares thoſe aft (n. 36.) to give her ſtern-way, the boarder has only to perform briſkly the ſame manœuvre, and they will then be both as near for boarding as before, provided the boarder be very quick in feeling the impulſe of her ſails and helm, which ought to be put a-weather (n. 50.) and kept ſo till the ſhip's headway ceaſes, when it is to be put a-lee (n. 58.), to aſſiſt her in falling off, in manœuvering as in box-hauling (Chap. III. Art. 2.), in order to board the enemy to leeward; for, the boarder ought to be on the quarter of the other, ſince at the moment the two ſhips were right before the wind, ſhe who was firſt to windward, and wiſhed to board, had only to continue her movement of rotation, and render her velocity equal to that of her adverſary, by ſhortening ſail in order not to paſs her. Now, if the circular motion is kept up by the boarder, which at firſt cauſed

him

him to fall off, and now brings him to the wind on the other tack, he will join the enemy to leeward; for, it is evident that if this motion of turning be more rapid than that of the ſhip which wiſhes to avoid boarding, the boarder will cloſe her before ſhe can range to the wind on the other tack, ſince he (the boarder) comes round with greater celerity. However, if the ſhip which fears boarding was preſſed as cloſely as is here demonſtrated, ſhe would have no other poſſible manœuvre to execute, but to throw once more all her ſails to the maſt, by bracing them only perpendicular to the keel to give her ſtern-way (n. 36.), and putting the helm a-weather, to keep her to the wind, as ſoon as her head-way ceaſes (n. 58.); obſerving that, ſhe being to windward, this manœuvre may cauſe her to drive on the boarder, as he is then looking for her under her lee. As there is no other reſource, neceſſity obliges her to hold to this expedient; becauſe, could the ſhip which is attacked go a-ſtern with a ſufficient velocity, ſhe might let the boarder paſs a-head, veer under his ſtern, and rake him, if he is not as quick as the other to foreſee this manœuvre, and as nimble in manœuvering in the ſame manner as the enemy's ſhip: becauſe, the great velocity with which he comes to the wind and goes a-head (his ſails being ſtill all full), puts him in this bad ſituation, which may prevent his perſiſting in the inclination of boarding. It is however very clear that the boarder will attain his purpoſe, if he takes care to throw all his ſails a-back at the ſame time as the ſhip to windward; becauſe, the attacked ſhip dropping to leeward, and having ſtern-way firſt, approaches a little the boarder, who has ſtill preſerved his poſition on the quarter, and longer kept his luff, by having gone a-ſtern ſomewhat later than the weather ſhip. But, it is farther to be obſerved, that when the two ſhips are right before the wind, if the veſſel which fears boarding moves quicker to the wind than the one which attacks, ſhe will avoid it, as the retreating ſhip will be cloſe to the wind before the other, and able to get

a-head of her by making all ſail to keep her wind, or to heave in ſtays and get upon the other tack. But, it muſt be conſidered that this laſt movement is an unfavourable one; as, by ſo doing, you will preſent your ſtern to a ſhip, which no doubt will take advantage of your ſituation, and rake you; which might be more deſtructive to you than a well-oppoſed attack by boarding.

THERE is however no doubt that if the ſhip inclined to board, ſails better than the other, it will always be in her power to execute that deſign, if ſhe has as great a knowledge of manœuvering as the ſhip which flies.

ARTICLE II.

PROBLEM.

To board to leeward, when cloſe to the wind, or to avoid being boarded.

SOLUTION DEMONSTRATED.

IN order to execute this manœuvre, the boarder is to come within piſtol ſhot, cloſe in the wake, or, at moſt, to the weather quarter, of the ſhip he means to attack; taking care to continue ſteering, as much as poſſible, ſo as not to be raked by ſome of the guns which belong to the quarter he ſtands on. Then, to come up with his adverſary, he muſt edge away a little, and range round aft ſo cloſe upon the enemy's lee quarter, that his cat-head may almoſt touch her quarter gallery. Now, when you have heaved ſhot ſufficiently a-head, and ſo (your ſhip being ranged parallel to your adverſary's) as to bring your forecaſtle abreaſt of your enemy's main-maſt, the mizen and mizen ſtay-ſail ſheets are to be hauled well aft, the helm put hard a-lee, and the head ſheets let fly; then, your ſhip, coming rapidly to the wind (nn. 40, 50, & 31.), ſhivers her ſails, and cloſes the oppoſing veſſel ſide to ſide. This manœuvre is infallible when you have the advantage of ſailing, provided very great attention is paid to it. I ſay here great attention is neceſſary: for,

for, if at this moment the weather ſhip, which wiſhes to avoid boarding, ſets her courſes, or lays all thoſe flat a-back which ſhe had ſet, ſhe may by one of theſe two manœuvres break the grapnels you have thrown on-board of her, unleſs you had the care to diſpoſe your ſails in the ſame manner as hers: becauſe the boarded ſhip, by making more ſail, will, if the wind be a little freſh, ſhoot a-head through the water, and the boarder will be dragged with ſuch a violence as to break the chains or hawſers with which the ſhips are confined together. By laying all flat to the maſt, the boarded veſſel has ſtill a better chance of ſucceeding, ſince the ſails of one of the two ſhips will be full while thoſe of the other are a-back.

Such a ſort of boarding may, as has been demonſtrated, be anticipated and avoided, if the boarder does not pay the ſtricteſt attention to his own manœuvres as well as to thoſe of his adverſary: but it may be with ſtill more advantage avoided, if the laſt mentioned veſſel braces her head-ſails ſharp a-back, ſetting only, if neceſſary, the fore-ſail (n. 37.), laying at the ſame inſtant all thoſe abaft to the maſt perpendicular to the keel (n. 36.), or ſhivering, as you may have more or leſs occaſion for ſtern-way, and putting at the ſame moment the helm hard a-lee (n. 58.) All this is to be executed when the boarder is ſtill about a ſhip's length (more or leſs) a-ſtern of the veſſel which is to perform this manœuvre. The quickneſs of this evolution, and the rapid veering of the weather ſhip which puts it in practice, may bring the veſſel inclined to board, and who is a little to leeward or a-ſtern of the other, into the moſt dangerous ſituation, if ſhe does not manœuver in the ſame manner and with equal celerity; as the boarder's ſails, being full, keep up his velocity, and may, before he can veer, engage his bowſprit in the main ſhrouds of the enemy, who pays ſhort round on her head.

This terrible and dangerous ſituation is infinitely to be dreaded; and it is of the higheſt importance to pay the ſtricteſt attention to

your own manœuvres and to the movements of your opponent, which you are to endeavour always to foreſee and avoid as much as poſſible: for, on that alone, depends the ſucceſs of all the manœuvres you have to execute.

REMARKS.

It is not difficult to conceive, that if you wiſh to board a ſhip, and to engage the enemy's bowſprit in your main ſhrouds, you have only to get a little to windward of her, and about one or two ſhips lengths a-head, more or leſs, as (from the knowledge you have of the celerity of your ſhip's movements) you judge may be ſufficient; then brace ſharp a-back your head-ſails, and ſhiver the after ones, or lay them flat to the maſt, by bracing them perpendicular to the keel *with the helm a-lee*. This manœuvre, well executed, and covered by a ſteady and briſk fire, will very ſeldom fail; but care muſt be taken not to veer too ſoon, and to come very cloſe to your adverſary; becauſe, if you ſhould not be a-head enough of him, you might very well miſs your boarding by paying too ſhort round him, and you would infallibly get your bowſprit foul of his fore ſhrouds, which would be very much to your diſadvantage.

If too far a-head, the deſign of boarding will be again fruſtrated, becauſe you cannot then avoid paſſing under the bowſprit of the enemy, who is however thereby expoſed to receive from you at his head a good raking, as you paſs athwart his fore foot, if he does not manœuver in the ſame manner and with equal ſwiftneſs as the aſſailer, who has the great advantage of priority in this tranſaction.

I say it is abſolutely neceſſary to range very cloſe to the ſhip whoſe bowſprit you wiſh to engage in your rigging; becauſe, if you attempted to execute this manœuvre at a ſhip's length large only and to windward of your opponent, he had only, the inſtant he perceives your deſign (and if he does not chooſe to act in the ſame manner as you do), to put the helm hard a-lee and heave in ſtays.

ſtays. If this evolution is properly executed, the two ſhips can but range very near each other and exchange their broadſides, and the lee ſhip will immediately gain the wind of her adverſary. Therefore, to execute properly and to a certainty this manœuvre, the veſſels muſt be nearly yard-arm and yard-arm.

If the boarder be at a certain diſtance aft on the weather quarter, the ſhip endeavouring to avoid boarding muſt take care to heave in ſtays, as ſoon as ſhe obſerves the other veſſel in the act of veering, in order to cloſe her to leeward. By this manœuvre they are head to head, and ſtem ſeemingly for each other, ſo that they have an opportunity of firing reciprocally their broadſides to advantage in paſſing on oppoſite directions, and the lee ſhip will get the weather gage of his enemy.

ARTICLE III.

To board with the wind large.

If two ſhips engage with the wind large, the veſſel inclined to board ſhould keep as cloſe as poſſible on the lee quarter of the ſhip ſhe means to attack, that ſhe may execute this deſign, as has been ſhewn before, by coming rapidly to the wind, and taking very great care not to paſs a-head of her opponent.

The weather ſhip, to avoid being boarded, muſt manœuver as directed in Art. II. according to circumſtances, or the deſign of the commanding officer.

A ship may alſo be boarded on the weather ſide, by conforming to what has been ſaid of boarding to windward.

When two veſſels are in action with the wind right aft, the ſhip deſirous of boarding ought to drop a-ſtern of the enemy, in order to run up cloſe along-ſide of him, if ſhe (the boarder) has the advantage of ſailing; for as ſhe advances towards her retreating adverſary, this has nothing in her power but to range rapidly to the wind on the other tack, as ſoon as the bowſprit of the aſſailant is a-breaſt of her

her ſtern, and gain the wind of him, in order to be in a ſituation to extricate herſelf with greater facility by a good manœuvre.

I SAY the ſhip inclined to evade boarding ſhould let her opponent come a-breaſt of her ſtern: becauſe, if ſhe were hauled to the wind ſooner, experience ſhews, and it is demonſtrated, that the ſhip a-ſtern (were ſhe at a ſmall diſtance) would board her perfectly well, even if they ſail equally ſwift, ſince the aggreſſor would be to windward, and run large longer than the other, in ranging more ſlowly to the wind, and continuing to ſtem a-head of the flying ſhip. What makes this more evident is, that the boarder coming from windward preſerves longer his velocity, and never trims his ſails but as the ſhip comes to the wind, and cuts the courſe of his adverſary with a line leſs curved than that deſcribed by the retreating ſhip.

IF, by coming too ſoon, or too faſt, to the wind, the boarder choſe to abandon his enterprize, he might do it in veering a little on the other tack, and leſſening his ſail: in which caſe the retreating ſhip will not fail ſhewing her ſtern, and the boarder has it immediately in his power to rake his opponent in paſſing under his ſtern, if he hauls to the wind.

WHEN you attack a ſhip cloſely to leeward, you may keep away a little, when you are a-breaſt of her, to make it appear as if you yielded under her fire. Then, if the oppoſing ſhip be dupe enough to give credit to your movement, and to veer without caution, with intent to keep you more under her guns, you have only to heave rapidly to the wind, by putting the helm a-lee, trimming all ſharp abaft, and ſuppreſſing the effect of the head-ſails; all of which is to be done in the ſame inſtant you perceive the enemy bears down upon you. The promptneſs of this manœuvre, and the priority of the movement you gain thus unexpectedly on your enemy, will ſoon cloſe the two ſhips; and, if proper attention be paid, and the diſtance judiciouſly meaſured, it may very probably happen that the enemy's

enemy's bowſprit will be engaged in your fore or main rigging; which would be the moſt advantageous thing which could happen to you in your attempt to board: but much confidence is not always to be put in this, as you do not every day fall in with people ſo liable to be duped: it may even happen that it will no longer be in your power to board, if the weather ſhip, inſtead of bearing away, plied to windward more and more; for, this feint manœuvre may bring you ſufficiently far off to leeward of your adverſary. If you ſhould happen to be a ſhip's length to leeward, and about the ſame diſtance a-head of the veſſel with which you are engaged, you may, under cover of a ſteady and well-directed fire, heave in ſtays. By this manœuvre you come right athwart the enemy's hawſe, rake him fore and aft, and board him, his bowſprit being right over your gangway: and, let him do what he will, he never can avoid your broadſide; for, if he heave all a-back and make a-ſtern board, which is his only reſource, he may undoubtedly avoid being boarded, but will nevertheleſs be in a very bad ſituation.

ARTICLE IV.

Boarding at an anchor.

If it be intended to board a ſhip which is at an anchor, riding head to wind, the manœuvre muſt be executed under ſail; for if you cannot approach the enemy but by ~~heaving~~ *lasking* yourſelf ~~to~~ *a* head, you will never be able to board her againſt her will; ſince it will always be in her power to annoy the boats which are laying out the tow-lines. It is therefore diſadvantageous to attempt boarding a veſſel at her anchor, unleſs you are under way. To perform this with ſucceſs, you muſt be ſufficiently to windward to approach her by a little falling-off, without expoſing your ſtern to her fire, which ſhe could play on you with great advantage in this ſituation. Suppoſing therefore the boarder to be in ſuch a proper poſition to windward,

ward, as to be able to approach his opponent at anchor, the aſſailant in this caſe ought to ſtop his head-way by taking a-back his mizen top-ſail and fore ſtay-ſail, and, when he is come about a ſhip's length a-head of the veſſel he means to board, let go an anchor; then manœuver in ſuch a manner that, as ſoon as the mizen top-ſail is taken a-back, the mizen cloſe aft, the top-ſails clued up, and the fore-top-maſt ſtay-ſail hauled down, he may come head to wind, and veer away cable till, by falling off, he comes board and board with his opponent, who is ſtill riding at her moorings, and who at that inſtant ought alſo to be raked by the boarder.

Whoever ſhall have read our next Chapter, on anchoring, will eaſily conceive that the ſhip inclined to board has no other way of manœuvering but that juſt mentioned; becauſe, as ſoon as the anchor is gone, the ſhip acquires ſtern-way, and when the cable is checked ſhe comes head to wind, in which ſhe is greatly aſſiſted by the mizen and mizen top-ſail, which impel her ſtern to leeward (nn. 40. & 44.) till the wind is right in the direction of the keel; and as you ought to have veered away the cable till you are exactly along-ſide the ſhip at anchor, and your own anchor is right a-head of the veſſel you mean to board, it follows that, as ſoon as your ſhip comes to be head to wind, ſhe is in a proper ſituation to throw her grapnels, and ſend her crew on board of the other, if they are the ſtrongeſt.

The ſhip at anchor ſhould never wait for the enemy in that ſituation, as it is always a very diſadvantageous one, and there is always a much greater probability of getting clear under way, provided your ſhip be tolerably good, and you know how to work her. But, if, for ſome unforeſeen cauſe, you are obliged to continue at your anchors, you are to take advantage of the moment when the ſhip which attacks lets go her anchor, to cut the cable by which you ride. By this manœuvre you fall athwart, rake your adverſary, avoid

avoid being boarded, and bring up with your lee anchor. Beſides, if time will admit before the attack, it will not be improper to caſt two ſprings out, one on each ſide of the cable by which the veſſel rides, if you have not had time before to lay out two anchors, in order not to be ſurpriſed, in caſe the ſhip which attacks has it in her power to paſs on either ſide of you: and, when you perceive for which ſide ſhe is determined, you heave on the ſpring which is on the ſame ſide ſhe has let go her anchor if ſhe be a-head, and on the oppoſite if ſhe be a-ſtern, veering at the ſame time on the other ſpring and cable, till you bring the aſſailant right a-breaſt of you. Then, you may rake him at pleaſure; as he has no way of getting out of this dangerous ſituation but by preventing it, *if he can; as he has a ſpring alſo, and may, under cover of a briſk fire, veer upon that ſpring and cable, and lay the enemy handſomely on board.* If he has neglected this precaution, he muſt cut his cable, and drop on board of the ſhip to leeward; who, on the other hand, has no way to avoid being boarded, but by cutting, to get under way, or to run on ſhore.

It is always eaſy to board a ſhip at anchor, when the wind will allow you to approach her under ſail; and the beſt way to proceed, is to run her along-ſide, or to bring-to to windward of the ſhip you wiſh to attack; and, keeping her exactly to leeward of you, drift on board of her, by manœuvering your ſails in ſuch a manner, as to keep, as much as poſſible, your broadſide oppoſite to that of the adverſe ſhip, in order to keep annoying her with your guns till you can cloſe her, and that your conſtant cannonading may prevent her fire being ſo well ſerved as it might otherwiſe be. This manœuvre is, in my opinion, the beſt which can be executed in ſuch a caſe as this.

When you are under way, and purpoſe to board a veſſel moored, care muſt be taken to let go an anchor at the time of boarding: for, if the ſhip attacked ſhould at this moment cut her cables to

drive on ſhore, you would by this means prevent your running a-ground together*.

CHAPTER X.

On coming to an anchor.

AS ſhips are often obliged to anchor with any kind of winds and weather, in ports and places of infinite diverſity, with reſpect to their ſituation and extent, I ſhall here produce the ſolution of a few problems relative to various circumſtances which moſt generally occur; laying down as a firſt principle that a ſhip ought never to come to an anchor unleſs under an eaſy ſail, that is to ſay, generally under the three top-ſails and fore-top-maſt ſtay-ſail, and ſometimes the mizen, according as the veſſel has more or leſs inclination to fall off, or come to the wind. There are, no doubt, caſes in which you may have occaſion to keep more ſail ſet; and theſe are exceptions to the principle, which are to be admitted as ſuch, without deſtroying the ſolidity of the ſame principle which remains, however, no leſs founded; becauſe, a great deal of ſail ſet is always embarraſſing, ſhould your ſhip's crew be ever ſo numerous. Very ſeldom, therefore, is anchoring attempted with all the ſails ſet (unleſs it cannot poſſibly be avoided), as the velocity of the ſhip's movements renders that manœuvre very difficult, and demands the utmoſt attention: beſides, you may happen not to have ſufficient room to ſtop the veſſel's head-way; in which caſe, you would run the

* ALL which has been ſaid in this Chapter about Boarding is hardly practicable but in ſmall ſhips, and ought never to be attempted without a known and evident ſuperiority of number. The moſt ſtrict attention is to be paid alſo to the ſwell of the ſea; as otherwiſe, from a mutual ſhock, the two veſſels might be in danger of ſinking. There are, however, to be found in this very Chapter many good manœuvres for ſingle ſhips of any ſize (without boarding) which, in all probability (were the caſe doubtful), might turn the ſcale of battle.

the riſk of getting foul of the anchor, by running over it; a circumſtance which would prevent it from catching and holding faſt, and requires therefore the greateſt attention in bringing up.

It is farther neceſſary, in manœuvering to come to an anchor, to take care not to drop to leeward of the place in which you mean to bring up; becauſe you would then be obliged to do it as you could, in the ſame ſituation, good or bad, in which you would find yourſelf, and very often to caſt two anchors at once, for fear of dropping ſtill more to leeward.

ARTICLE I.

PROBLEM.

To anchor in fine weather, in a place where you are to ride head to wind, the ſhip being cloſe hauled.

SOLUTION.

Being cloſe hauled under the three top-ſails, fore-top-maſt ſtay-ſail, and mizen, ſtand on until you are within two ſhips lengths (more or leſs, according to the qualities of the veſſel) of the place in which you mean to drop your anchor; then put the helm a-lee, and haul down the fore-top-maſt ſtay-ſail. As ſoon as the top-ſails ſhiver, clue them up briſkly in looſening them before you lower them; lay the mizen top-ſail to the maſt, and haul aft the mizen ſheet, the inſtant the ſhip begins to heave ſtern-way, with the wind being a-head. Then is the time to ſhift the helm from leeward to windward, and let go the anchor, veering away the cable to give it time to ſettle in the ground, or until the veſſel falls off, when ſhe is to be checked, in order to bring her head to the wind. When that is done, you right the helm, and brail up the mizen, to complete the evolution.

DEMONSTRATION.

The ſhip is heaved up in the wind by hauling down the fore-top-maſt ſtay-ſail (n. 31.), when nearly two ſhips lengths from the

ſpot you mean to drop your anchor in, becauſe the ſhip's head-way is ſufficient to ſhoot her that diſtance; and as by this movement the ſhip generally ſtops a little to windward of the place where you mean to bring up, you wait till ſhe begins to go a-ſtern a little before you let go the anchor, and the helm is at the ſame time ſhifted hard over the other way (n. 58.), to moderate the ſhip's falling off when ſhe is head to the wind. The top-ſails are clued up as ſoon as they begin to ſhiver, not only becauſe it can at that time be done more eaſily, ſince they come in of themſelves as they lower; but becauſe, if they were delayed longer, the ſtern-way would become too rapid (ſince the ſails would be all a-back), and would quickly drive the ſhip to leeward of her intended anchorage. Beſides, the celerity of her falling off would be ſuch, as to cauſe her to drag the anchor before it could have had time to get a proper hold of the ground; a reaſon why the cable is veered away, in order to give the anchor time to ſink into the bottom by its weight. The mizen top-ſail is braced perpendicular to the keel; becauſe, in that ſituation, the ſhip is impelled (n. 36.) a-ſtern exactly in the tendance of her keel. The mizen ſheet is hauled flat aft, to bring the ſhip's head ſooner to the wind (n. 40.); and, as ſoon as ſhe arrives at that point, that ſail ſhivers; in which caſe it is immediately brailed up, as being no longer of uſe. The helm is righted, as having no longer any power; ſince the veſſel is now brought up, and all the ſails are furled, except the mizen top-ſail, which is flat a-back on the maſt, to keep the ſhip ſteady at her anchor. All being ſo, the problem is reſolved.

REMARKS.

If you were to run for any anchoring-place with the wind large, whether on the beam, or more aft, your manœuvre would be ſtill the ſame, only hauling up a little ſooner to keep to windward, becauſe it is always in your power to drift as much as you think it requiſite, and becauſe the ſhip will be entirely ſtopped as ſoon as

all

all her ſails begin to catch a-back, and you will have done cluing them up when they begin to ſhake. The mizen top-ſail is next to be heaved to the maſt, the helm put a-weather (n. 58.), and the anchor let go, as ſoon as the head-way ceaſes: then, after giving her a ſufficiency of cable, bring the ſhip up. It is evident that, as ſhe has been going large, ſhe will not range preciſely head to wind, ſince her head-way ceaſes as ſoon as the ſails are taken a-back, and the effort of the wind acts on the hull and rigging of the ſhip to impel her both a-ſtern, and to leeward, which is in fact augmenting the effect of the rudder, as the helm is a-weather to bring the veſſel to the wind (n. 58.): but, as the power of the wind is very great to pay the ſhip's head off, it balances wholly or partly the effort of the rudder (according as the ſhip goes a-ſtern with more or leſs velocity) and that of the mizen: thus ſhe drifts, and remains as it were lying-to with all her ſails a-back. It is the reaſon why we keep a little to windward, and let go the anchor, to bring the ſhip head to wind when the moment is come, which ſhe will obey rapidly, being withheld only forward by the cable, while the wind on her ſide forces her to leeward.

If you are obliged to ride with the head to the ſtream, you muſt, when it comes from to windward, put the helm a-lee in ſetting the mizen, then clue up all the ſails; and, when the ſhip's head is right in the direction of the ſtream, let go the anchor (provided you find ſhe has quite loſt her head-way); for, elſe, you would get foul of the anchor-ſtock by running over it. This is an attention you muſt never neglect, in all caſes, unleſs you find yourſelf under the neceſſity to bring up in any ſituation in which you may happen to be, which is almoſt always the caſe when you are taken too ſhort and too ſuddenly to have time to ſtop the veſſel: a reaſon why there is often a neceſſity of caſting a ſecond anchor, which generally catches ground by the aſſiſtance of the firſt, which has began to diminiſh the velocity of the ſhip; and as many of the ſails are to be hauled down as you can, and as quick as poſſible.

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In a caſe when the current would come from to leeward, you muſt keep the ſhip away till her head comes to the ſet of the ſtream, and take in all the ſails, to diminiſh with all poſſible ſpeed her head-way, which always continues of itſelf long enough when the wind is aft or very large; and when the ſhip is ſtopped by the effort of the water, let go the anchor without (if the current is rapid) waiting for the veſſel gathering ſtern-way; and, in this caſe, as well as all thoſe wherein there is a ſea, or blowing freſh, the ſhip requires a great deal of cable.

If you come to an anchor when it blows ſo freſh as to oblige you to reef your top-ſails, you ſtill act as above directed, taking great care to foreſee the velocity of the ſhip's movements, and paying more attention to the manœuvre, which now becomes more difficult, every thing growing more unhandy as the wind freſhens; becauſe the ſhip has got a ſtronger head-way, and that it is often too late that we attempt to repair the fault of a bad manœuvering. It is in ſuch ſituations, and in all thoſe which are critical, that we diſcover the ſuperior ſeaman; who lets nothing eſcape, which can poſſibly contribute to the ſpeedy execution and ſucceſs of the manœuvre intended to be made.

ARTICLE II.

PROBLEM.

To come to an anchor with the wind aft.

SOLUTION.

You muſt begin firſt by handing the main top-ſail, and then lowering the fore top-ſail down on the cap; and, when you are within a reaſonable diſtance of the place where you mean to drop your anchor (which diſtance is to be computed and judged from the readineſs of the ſhip in obeying the helm, and its velocity), the tiller may be put either one way or the other (n. 50.), the fore top-ſail and fore-top-maſt ſtay-ſail clued up and taken in, the mizen top-ſail

top-ſail braced ſharp up, and the mizen ſheet hauled flat aft. When the ſhip has ranged cloſe to the wind, ſhe is as it were lying-to under the mizen and mizen top-ſails, with the laſt-mentioned ſail full, or a-back, according as you may have occaſion to ſhoot a-head or drop a-ſtern; ſo that, if you are too much to windward of the ſpot where you mean to bring to, you drift till you arrive at it: if you are preciſely in the birth wiſhed for, you let go the anchor in lowering down the mizen top-ſail, which is to be furled as ſoon as the veſſel is brought up; then the ſhip will come head to wind by the power of the mizen, which muſt be brailed up as ſoon as it ſhakes.

DEMONSTRATION.

The main top-ſail is taken in, and the fore top-ſail lowered down, to diminiſh the great velocity which a ſhip commonly has when the wind is aft, in order to eſtimate the diſtance with greater preciſion, and to have her movements under a greater facility of command. When you think yourſelf at the neceſſary diſtance the ſhip requires to ſtop cloſe hauled, at the place you wiſh to anchor, you put the helm ~~on board~~ Hard over one way or the other (n. 50.); you brace ſharp the mizen top-ſail for the tack you haul upon (n. 41.), and haul the mizen out to bring the ſhip rapidly to the wind (n. 40).

In the ſame moment, the fore top-ſail is to be clued up and handed, and the fore-top-maſt ſtay-ſail hauled down, becauſe they oppoſe the movement of the ſhip as (nn. 31, 32, & 33.) ſhe is coming to. When you are cloſe to the wind, the anchor is let go, if you are in the birth you wiſh. If too far ſtill to windward, you can drift, keeping the mizen top-ſail full; and, when you are to windward, ſhould you find yourſelf too far a-head, you have only to lay the mizen top-ſail a-back to go a-ſtern (n. 44.), putting at the ſame time the helm a-weather (n. 58). When the veſſel has drifted ſufficiently, let go the anchor, and furl the mizen top-ſail; becauſe

becauſe the cable might be ~~fatigued~~ ſtrained, ſhould it come to blow freſh: then the ſhip will ſoon range head to wind, though the mizen be ſtill out (n. 40.); and, when that point is attained, the mizen is brailed up to prevent the ſhip ſheering; and the helm is righted for the ſame reaſon.

THE ſhip being at anchor without ſails, and without motion, the problem is ſolved.

REMARK.

THERE are certain circumſtances in which you are obliged to come to an anchor with the wind aft, ſtanding end on, becauſe there is not always the ſpace neceſſary to deaden the ſhip's way. In this predicament the ſails are to be taken in as ſoon as poſſible, in order to leſſen the great impetuoſity of the ſhip's head-way.

WHEN you are come to your birth, the anchor is to be let go, and the cable veered away plentifully, that the anchor may have time to ſink in the ground; then begin to check her gently, veering ſtill more cable in proportion as the ring-ropes or ſtoppers, you are to have placed on it before-hand, ſnap; for they are to be made of a ſnapping quality, that, by attempting to bring the veſſel up at once, you may not be expoſed to drag your anchor.

OBSERVATION.

A GENERAL RULE.—When the wind is not violent, the top-ſails ought always to be clued up at the maſt-heads; that is to ſay, the ſheets muſt be let go, the clue-lines and bunt-lines hauled cloſe up and above the top; then lower away the top-ſails roundly, ſtill hauling on the cluelines and buntlines to keep them cloſe up, and haul through the ſlack of the braces as the yards come down; ſo that the ſails, when on the cap, are found ready ~~furled~~ braild up and well.

THIS method of taking in the top-ſails is the moſt expeditious, and does not expoſe them, when the wind is not abſolutely ſtrong, ſo as to oblige you to ſtrike them down a-portoiſe: and, in manœu-

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vering in this manner, you run leſs riſk of ſplitting or tearing the ſails than by any other method.

ARTICLE III.

PROBLEM.

Scudding under a fore-ſail to come to an anchor.

SOLUTION.

When obliged, by ſtreſs of weather, to run under a fore-ſail only and come to an anchor, you muſt take it in before-hand, and, the reſt of the way, run under bare poles*. When you are come to the neceſſary diſtance to ſheer to the wind, you execute it by putting the helm hard a-lee: and, as ſoon as the ſhip is come to, let go the anchor. In this caſe, ſhe will require a great ſcope of cable, and to be checked handſomely, with ſnapping ring-ropes put on before-hand, in order to make her come head to wind: as ſtopping her at firſt too ſhort might very well endanger her cable or anchor. Should the firſt not bring her up, a ſecond muſt be let go.

DEMONSTRATION.

As you cannot run for an anchorage under a fore-ſail, unleſs before the wind, or very free, you are neceſſarily obliged to furl that ſail at a great diſtance; becauſe, in that poſition, the velocity of the ſhip will, by the violence of the wind, be but too much kept up, ſo as to make you run the reſt of the way, which may perhaps be a quarter or half a league, under bare poles, the wind being

* During this interval, the lower yards and top-maſts are to be ſtruck: long ranges bitted of the two bower cables are to be got upon deck: the neceſſary quantity of water by the bitts, ſtoppers of every kind and ring-ropes are to be ready for ſervice in their proper places: the ſheet anchor is now ſuppoſed to be over the ſide clear for letting go.

being nearly aft. If you were obliged to run at that diſtance cloſe hauled, you would never reach your birth, ſhould the fore-ſail even be ſet; becauſe, as was ſhewn before, the ſhip would be laid-to. You put your helm over to ſheer to windward when you think you are at the neceſſary diſtance, that you may have time to deaden the ſhip's head-way: and as, when ſhe ſtops coming to, her head-way ceaſes, you let go the anchor, and veer away a great extent of cable; becauſe, when it blows hard, there is commonly a great ſwell, and the pitching motion it gives to the ſhip, joined to the effort of the wind on the whole machine, would bring home the anchor. It is therefore abſolutely neceſſary to veer away a great length of cable, to give the anchor time to ſettle, and to cauſe the cable to make a very acute angle with the ground, that the ſtrain may be more perpendicular on the flukes of the anchor which is buried in the ſand.

ARTICLE IV.

PROBLEM.

To anchor with a ſpring, in order to preſent the veſſel's ſide ſuddenly to a place or ſhip you wiſh to cannonade.

SOLUTION DEMONSTRATED.

THIS manœuvre is executed when you know that the wind or current will bring your head, when at anchor, towards the object you mean to attack: for, ſhould the wind or tide bring your broad-ſide to bear on the object you mean to cannonade, the ſpring would be but a mere precaution, to get under way with greater alertneſs, in caſe you were ſo handled as to be obliged to retreat; or in caſe the wind or tide ſhould ſhift.

IN the firſt caſe propoſed, this evolution will be executed with ſucceſs, if the attacking ſhip fixes a large ſnatch-block in the aftermoſt port, on the ſame ſide you wiſh to preſent to the wind or current, and on the ſame ſide with the anchor and cable with which you

mean

mean to bring up; then, through the block, is to be reeved a hawſer, the end of which is to be carried forward and clinched to the ring of the anchor; the other part is to be brought to the after capſtern, after having firſt taken the neceſſary ranges of the cable and hawſer according to the depth of the water you are to bring up in. That done, and the ſhip being arrived at the birth, you are to deaden her way according to circumſtances: you let go the anchor, and veer away enough cable and hawſer, now a little more of the one, and then a little more of the other, according as you wiſh to preſent more head or ſtern; which you can do by heaving on the ſpring, or, what is the ſame, veering away more cable; but ſhould you find it requiſite to ſhift your poſition, you have only to veer out more of the hawſer. All this ought to be eaſily conceived, after what has been ſaid before.

END OF THE SECOND PART.

AN

ESSAY

ON

NAVAL TACTICS.

PART THE THIRD.

Various Obſervations on the Marine.

THIS Part will preſent us the Mariner intirely taken up with the care of foreſeeing, commanding, acting, regulating, and keeping every thing in order within: enabling himſelf to operate afterwards with celerity, accuracy, and no confuſion. As for what is to appear outwardly, it is the fruit of reflexion.

CHAPTER I.

Of the uniformity which ſhould be introduced among the ſeveral maſts of ſhips; of their height and ſituation.

I. THE right height to be given to the maſts of ſhips, is ſtill, for the builders, a problem which remains to be ſolved. Some contend for more, ſome for leſs. The moſt ſkilful among theſe gentlemen have not paid attention enough to the ſolutions and determinations which are contained in the Works of the late Mr. BOUGUER

Bouguer on that ſubject. It ſeems, on the contrary, as if they had made it a point to deviate, as much as poſſible, from the true principles in that reſpect, by raiſing the maſts a great deal more than they were formerly, although they were already much too high, as the learned Author I have juſt mentioned has aſſerted. An experience, confirmed by obſervations out of number repeatedly made on my ſide, has convinced me of the following truth; *viz.* that "as ſoon as a ſhip inclines, her velocity diminiſhes in the ſame ratio as her inclination increaſes." I have not been the only one who has made theſe obſervations: ſeveral officers, without any participation of mine, have verified the ſame principle on different veſſels, and at different periods of time, and in all thoſe various courſes which are termed oblique with reſpect to the direction of the wind. As I had no ſhare in thoſe various experiments, I cannot be ſuſpected of partiality: but, as they have always ſhewn to thoſe who have condeſcended to make them, that the preſent mode of maſting is generally too high, I will not heſitate a moment longer to deliver here an epitome of my own experiments on that ſubject.

Having all the ſails out, and being hurried on by a ſtrong gale, I have ordered all the top-gallants, the ſtudding, and the ſtay ſails, to be taken in, without the ſhip loſing the leaſt perceptible degree of her velocity; moreover, I have ſeen it ſometimes to increaſe by a twentieth, and that even at a time when the ſhip ran already at the rate of nine or twelve knots an hour.

These trials, which I have made with care, and had executed with celerity enough, that the wind ſhould not have time to increaſe or diminiſh in ſtrength, are ſufficient to prove the neceſſity of lowering the center of the effort of the ſails in general, and therefore all the maſts. I have repeated my experiments in augmenting the number of ſails, even at the riſk of ~~fatiguing~~ straining ſometimes the maſts themſelves; and I have always found that the velocity did not increaſe,

increaſe, when the ſhip was more inclined; but that ſhe laboured more and more in all her parts, as her movements became ſtronger and the concuſſions of her pitchings rougher, although the ſea was not more ſwelled than before. At other times, when the ſhip inclined pretty much, though the wind was not quite ſtrong enough to hurt the maſts, I have ordered the ſails to be diminiſhed; and it happened that the ſhip, after that ſuppreſſion of the top-ſails, was eaſier in her movements, ſteered better, and was more quiet, though the ſwells of the ſea were ſtill the ſame; an attention which muſt not be neglected in theſe kinds of obſervations, which cannot be too often repeated before venturing on a deciſion. However, our intention is not here to point out any diminution in the ſurface of the ſails, although we recommend a diminution in their height. On the contrary, it will often happen that we ſhall rather recommend increaſing it upon the whole. For, the loſs which is apprehended from the abating of the height, may eaſily be regained, in my opinion, by the width. There will even reſult, from that operation, another advantage: the top-ſails, by this reform, being ſhorter and, thereby, proportionally wider than the lower ſails, will be more eaſy to be ſhaped in cutting; and their ſides being formed with lines exactly ſtrait, the ſail will be the more taught, a principal quality by which it will always be found to produce a much greater effect on the ſhip. The maſts being ſhorter, and the ſails wider, with leſs fall, the ſurface will be the ſame: but the effort of that ſurface will, with the ſame wind, act on ſhorter levers, the fulcrum of which ſhall not have been altered; therefore, it will operate at a ſhorter diſtance from that fulcrum; and therefore much leſs will be the power which cauſes the ſhip to incline: and the ſhip, finding herſelf more upright, will ſteer with more velocity, becauſe her water-lines will be then more advantageous than when ſhe heels. On the other hand, the leſs the ſails are inclined, the wider is the ſurface they preſent to the wind, and the ſtronger, of courſe, the impulſion they receive from it: an

advantage

advantage which cannot fail to produce an increaſe of ſwiftneſs and a decreaſe of drift. To this let it be again added, a real and important advantage, *viz.* that of trimming much better the ſails, of bracing them with more eaſe and command, and rendering the whole maſting more ſolid in general, and more capable to reſiſt in bad weather as well as in an engagement.

But, how are we to come to the determination of the right height to be allowed to the maſts in ſhips? or, which is the ſame, the right quantity they are to be ſhortened, according to the principle of their preſent conſtruction? The *Treatiſes on the Art of finding the perfect point for the maſting and manœuvering of ſhips, by M.* Bouguer, teach us that method. It is in thoſe very Treatiſes I have imbibed the firſt notions of my principles on that ſubject. But, in order to give an anticipated idea of that curious inquiry, and to engage the builders and ſeamen to bring to perfection this part both of the building and manœuvering of ſhips, from which, as much as from their bottom, moſt undoubtedly depends their ſteerage, I will mention here what M. Brue, a very learned and ſtudious Officer, made me conceive on that head: and, for the ſake of doing juſtice to his inſtruction, I will repeat his own words:

"That maſting," ſaid he, "is abſolutely perfect, when the "center of the effort of the ſails is preciſely oppoſite to, at the "ſame height as, or parallel with, the *point-velique*. Now, what "is the *point-velique?* is the queſtion. The *point-velique* is that "where a perpendicular, raiſed from the center of gravity of the "floating line of a ſhip, comes, in a direct courſe, to be interſected "by the direction of the abſolute impulſe of the ſea on the prow "of the veſſel."

It is clear; there is no need of any great effort of imagination to conceive this principle. As for my part, I find it ſo ſelf-evident, that I wonder how thoſe who make it their profeſſional buſineſs to build ſhips, have not yet made uſe of it. For, this *point* once known, it is certain that of the center of effort of the ſails will be

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ſo too; and their right height, as well as that of the maſts, muſt follow of courſe, and be determined. A little more calculation, I confeſs, will be required, as well as attention, on the plan of the ſhip, in order to find out that determination of the direction abſolute of the effort of the impulſion of the water on the prow. But, it muſt not deter us from purſuing it. On the contrary, it ſhould, I think, be an additional inducement for thoſe who, building ſuch good veſſels as we are now poſſeſſed of, and as might ſtill be of a more advantageous form, will be deſirous to make them ſtill more perfect, in maſting them in a more advantageous manner. And this would undoubtedly be the caſe; as I could mention ſeveral veſſels, the cutting ſhorter of whoſe maſts has been attended with the greateſt ſucceſs. Theſe facts, which could be atteſted by many able ſeamen, will always ſpeak highly in behalf of this principle; although, when that ſhortening was made, they miſſed having the attention of widening the ſails in proportion, in order that they might gain that way what ſurface they had loſt by the lowering of their heads.

"But," continues M. Brue, "in carrying this inquiry farther "than it ever was, we find that the interſection of the two above-"mentioned lines, *viz.* that of the impulſe abſolute of the water on "the prow, and that of the perpendicular at the center of gravity of "the ſurface of the floating line of the ſhip, cannot take place unleſs "in a direct courſe; and that, as ſoon as the courſe becomes oblique, "they no longer meet. The center of gravity of the floating line's "ſurface of the ſhip paſſes to the leeward of its axis, on account of "the proportional inclination which always is the neceſſary conſe-"quence of that ſort of courſe; and the direction of the ſhock of the "fluid, which then takes its origin a little to leeward alſo of the prow, "paſſes in its prolongation to windward without meeting the per-"pendicular at the center of gravity of the floating line's ſurface," (a circumſtance not difficult to conceive, if we endeavour to repreſent to our imagination the horizontal edge of that floating line's ſurface

face but ever ſo little inclined); "whence it reſults that no *point-*
"*velique* could be found in any courſe but a direct one: which is
"true; unleſs the imagination could fancy ſuch a ſhip as would
"neither drive nor incline in an oblique courſe: but none of that
"kind can, or ever will, be found; hence no perfect mode of maſt-
"ing could be diſcovered in the laſt caſe of the oblique courſe."

THIS is true, rigorouſly ſpeaking: for, each inſtant of a courſe has its particular and different point of the prow which is ſtruck by the water; a variation which is owing to that of the ſtrength of the wind, to the pitching of the ſhip, and to the greater or ſmaller inclination which the rolling motion of the ſhip produces.

"BUT," ſays again M. BRUE, "after having given an evident
"demonſtration of the laſt principle, unneceſſary to repeat here,
"the *point-velique*, relative to the various circumſtances juſt men-
"tioned which accompany the courſe of a ſhip, varies therefore in
"the proportion of the almoſt infinite variety of thoſe ſame cir-
"cumſtances, that is to ſay, according to all the degrees of drift,
"all the degrees of inclination on either board, forward or abaft;
"as many times, in ſhort, as there are new points of the prow
"either ſtruck, or no longer ſtruck, by the fluid, the *point-velique*
"aſcends or deſcends.

"I PASS over the minute examination I could make of each
"ſingle and particular cauſe which contributes to lower that *point*
"from its utmoſt height, as it were, which is in the direct courſe,
"to its loweſt, which never happens but in the moſt oblique courſe,
"accompanied with the greateſt lateral inclination of the ſhip:
"and I ſay there is no method to get out of that common beaten
"road which is purſued in determining the dimenſions of the
"ſeveral maſts, but that of paying the greateſt attention to the
"following conſiderations; *viz.* Such a ſhip being intended for
"ſuch a latitude, the wind ſhe is moſt commonly to expect there,
"will be nearly of ſuch a ſtrength, and generally oblique to her

" courſe by ſo many degrees: ſo that her moſt common drift will " be nearly ſo many degrees, and her lateral inclination ſo many, " &c; in order to give her, therefore, the moſt ſuitable maſting, " or, in other words, the moſt perfect, relatively ſpeaking, we muſt " ſeek for her *point-velique* in what ſituation we ſhall think moſt " convenient, and there place the center of effort of her ſails".... Now, all this reaſoning tends evidently to recommend the ſhortening of all the maſts, and to prove the neceſſity of doing it, at the ſame time as it determines their height. The moſt difficult point, in that operation, will be to find out the direction of the abſolute impulſion of the water on the prow, when the ſhip ſteers a courſe cloſe hauled or with the wind on the beam, with ſuch an inclination as the ſhip could be ſuppoſed to have in either of theſe two courſes, and admitting alſo that the gale would allow to have four ſquare-ſails out, along with the mizen top-ſail. Granting theſe two ſuppoſitions of the wind on the beam or cloſe hauled, it will be eaſy to determine the height of the maſts proper for that double ſituation; becauſe, if the gale blows harder, one may leſſen the number of ſails; if weaker, one may increaſe it by adding ſtay-ſails, top-gallant ſails, jib, &c: if the gale ſtrengthens, then the ſurface of the ſails may be increaſed again by adding the ſtudding and top-gallant royal ſails: finally, it is very clear that top-gallant and top-gallant royal ſails will always be of ſervice when the center of the effort of the ſails will be wanted to aſcend.

PUTTING aſide all the abſurdity of prejudicial habit, this demonſtration and our reaſoning muſt, upon examination, appear evident, provided the oppoſition which the natural lazineſs of man muſt be expected to throw into the ſcale ſhould alſo be rejected; for, there is no doubt but calculations much more prolix than difficult, and which are tedious enough, will moſt certainly be requiſite: but, they will be attended, in the end, with real advantage; and that labour is certainly not to be regretted, which is to be followed by the

the improvement of thoſe who ſhall have condeſcended to give themſelves up to it. Beſides, however repugnant it may be to any one prejudiced againſt it, I do not imagine that prejudice can have any power againſt a truth eſtabliſhed by all that we have juſt, ſaid, as well as by the experience of many able ſeamen, more diſpoſed, it is true, for making obſervations, than really learned on the ſubject, but in whom good ſenſe and truth ſpeak intelligibly enough to deſtroy that obſtinate prepoſſeſſion implanted by bad habit and cuſtom, which ſometimes operates powerfully on the minds of many, who enter into the ſea line, without the neceſſary previous information.

II. I AM going now to propoſe an idea relative to that ſubject which appears to me as reaſonable as it is well grounded: I ſay that every thing which concerns the *fore*-maſts ſhould be made in every reſpect equal to, and uniform with, the *main*-maſt. For, what can be the uſe of that difference in height, in bulk, in ſize, between the maſts and between the ſails? Of no other certainly but multiplying difficulties, of which it might be very eaſy to get rid, by rendering every thing uniform, the maſts, the tops, the yards, the ſails, the ſhrouds, the ſtays, and, in general, all the ſtanding and running rigging. In obſerving, which is very eaſy, to preſerve the center of the effort of the ſails at the ſame height as the *point-velique*, it will be impoſſible to loſe any thing of the impulſion or of the direction, ſince the ſurface will always be the ſame and diſpoſed in the ſame manner. The advantage which will be deduced from it will be, firſt, an equality in the manœuvres and in the manœuverers about the various and diſtinct parts of the ſhip: ſecondly, a great ſaving will be the reſult, if put in practice; for, the rigging and the change of any of the maſts, will ſerve for another maſt, which cannot be the caſe in the preſent ſituation of things; for, whatever is uſed forward is too weak for abaft, and *vice verſâ*. There will be no need of different blocks, nor of ropes of different ſizes; all will

be alike. The fore-ſails and their yards will do abaft; there will be need but of a double ſet of thoſe kinds of ſtores: this uniformity will certainly be very advantageous; and its utility ſeems to me ſo ſtriking and ſo eſſential, that I cannot imagine the leaſt doubt can be entertained about it.

III. The power, or the effort, of the ſails on the ſhip ought to be diſpoſed in ſuch a manner that, being all equally trimmed and in the ſame way, they will be in equilibrium round a certain point, on the axis which is determined by the union of the direct impulſions of each of the parts of the prow equally divided into two parts by the axis of the floating line's ſurface. So that, the ſection on the axis of the directions of the effort of the fluid on each ſide of the prow in the direct courſe being known, and ſuppoſing the ſurface of the ſails a-head to be equal to that of the ſails abaft, the fore and after maſts will be reciprocally placed at an equal diſtance from that point. But, if the courſe be oblique, then it alters the caſe in a due ratio between the greateſt and the leaſt obliquity, as well as between the greateſt inclination of the ſhip and her moſt upright or horizontal ſituation. So that, in order that the maſts may, in ſuch a circumſtance, be properly placed, it is neceſſary to find out the middle direction, between the direct and the lateral efforts of the fluid on the prow in the ſuppoſed oblique courſe, and the inclination which will be conceived as being a neceſſary conſequence of it. Then, the point of ſection of the direction of that middle impulſion on the axis, coming from leeward, will be that round which it will be proper and neceſſary to place in equilibrium the effort of the ſails at the time of ſtepping the maſts, under the ſuppoſition however, as we have ſaid before, of a courſe, or of an inclination of the ſhip which ſhall be the moſt relative to the qualities wiſhed to be given her.

In order to find out afterwards the direction of the effort, or impulſion abſolute, of the prow in the oblique courſe, it is neceſ-

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ſary to know firſt the direct, the lateral, and the vertical impulſions. The two firſt will ſerve to draw a parallelogram, the diagonal of which, ſtarting from the point of union of theſe two impulſions on the exterior part of the leeward of the prow, will cut the axis of the floating line's ſurface according to the ſide of the ſhip; and that point of ſection of the diagonal, or, what is the ſame, the direction of the impulſion, which is a middle one, between the direct and the lateral with the axis, will be that where the ſet of maſts is to be placed; for, it is round that point the effort of the ſails is to be placed in equilibrium.

If, at the two extremities of the diagonal, formed by the direct and the lateral impulſions, two perpendiculars be raiſed and made ſo as to be equal to the vertical impulſion, (after having confounded and united into one and the ſame the three points of the prow's ſurface on which they act); and if, afterwards, a line be drawn along their extremities parallel to the firſt diagonal, a ſecond rectangle thereby will be obtained vertically ſituated, the diagonal of which, ſtarting from the point of union of the three impulſions on the exterior ſurface of the prow, will give the direction of the effort abſolute of the water on the prow of the ſhip: and this direction, meeting (as we ſaid before) the perpendicular in the center of gravity of the inclined floating line's ſurface, or on the horizontal one which ſtarts from it on the windward ſide, will mark, at the point of this interſection, the height of the *point-velique* for this particular oblique courſe, and conſequently the height of the center of effort of the ſails, whence the height both of the *lower* and of the *top* maſts is to be taken: for, as to the top-gallant maſts, they ought to be arbitrary, as they are but ſuppliers to the want of wind, a quality they have in common with the top-gallant royal.

CHAPTER II.

Obſervations on the different inclinations given to the maſting of ſhips, with reſpect to the water-line.

THE maſts are hardly ever ſtepped in the ſame manner in every ſhip. That operation is again one of thoſe which are rather ſubmitted to cuſtom than judgement. Some will have them perpendicular, while others chuſe to have them lean forward, and others prefer to have them lean abaft. Each party bring, to the ſupport of their opinion, reaſons drawn from ſome experiment or other which chance has ſometimes rendered ſpecious enough to give room for their favorite error.

IN diſcuſſing theſe various opinions, mariners, in general, ſeldom care to examine whether the ſhips are alike, and whether what they inſiſt upon is conformable to principles, or not. So that, while they repeat the ſame thing in one ſhip as they have already practiſed in another, they preciſely do the contrary of what they want to execute. But, without carrying this digreſſion any farther, let us return to our ſubject. In this reſpect, confidence muſt be given to the ſagacity and judgement of the builder, who ought to know the qualities of his ſhip even before he undertakes to put her on the ſtocks. If one has not an opportunity of taking directly from him the neceſſary inſtructions, it is proper, however, to take notice that, if the leaning of the maſts is ſo calculated as to be forward, the direction of the effort of the ſails will be inclined towards the bottom, obliquely with the horizon; whence it reſults that they will make the head of the ſhip to plunge whenever they receive a ſtrong impulſe from the wind, which may diminiſh the head-way of the ſhip, while it increaſes, at the ſame time, the celerity of the pitching: the ſails alſo will beſides be with more difficulty trimmed, eſpecially when circumſtances ſhall require them to be cloſe hauled,

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ſince the bracing of the yards will be more confined. Therefore, the only advantage which can be drawn from this oblique maſting of ſhips, is only to render the ſhips more ready to fall off.

If the maſts are ſtepped perpendicularly, the direction of the effort of the ſails will be horizontal, always ſuppoſing the ſhip to be in an upright poſition. Therefore, this effort not being diſcompoſed, it will preſerve a much greater action, and the ſhip will ſail with the greateſt velocity ſhe is capable of.

If the maſts are leaning abaft, the ſhip will be more ready to come to the wind, becauſe the ſails will be a little more aft: theſe will alſo be more eaſy to trim ſharp on account of the braces not being ſo much confined. Now, as this poſition of the ſails will raiſe obliquely above the horizon the direction of their effort on the ſhip, it reſults that, by their power, the ſhip will find herſelf very much eaſed away from the water: for, it is moſt certain ſhe will not prolong her courſe, unleſs ſhe leans by a great deal too much; therefore, ſhe will riſe much lighter over the waves of the ſea, pitch leſs, keep better the wind, and tack quicker. Such is nearly all that can be ſaid in reſpect to practice.

CHAPTER III.

Of the cut or ſhaping of the ſails: of their tenſion, and tendency to fix themſelves perpendicularly to the direction of the wind.

1. STARTING from the principle of ſhortening the maſting of ſhips by increaſing the length of the yards in general, and of courſe the extent of the ſails upon them, it will be very eaſy to cut the top-ſails; as thereby their ſides will no longer be formed of any other but ſtrait lines. The courſes, or lower ſails, will alſo have the ſame advantage. But, ſometimes (though as ſeldom as poſſible) it will be found neceſſary to cut them ſo, that the foot of the ſail ſhould be narrower than the head or ſquare ſide, in order that they

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may be made more taught in trimming. (This mode of ſhaping them, for example, will always be requiſite whenever it is poſſible to place their cheſs-trees perpendicularly, and to tack the clues of the fore-ſail on the forecaſtle inſtead of placing it on the knee of the head or cutwater, under the extremities of the lower yards.) The top-gallant, as well as the top-ſails, will have nearly the form of a ſquare, as their ſhape will be that of a trapezoid, the parallel ſides of which will be almoſt equal. But, in giving the dimenſions for the top and the top-gallant yards, it will be proper to order the arms and ends, where the cleats are made for the reefs, longer than they uſually are; and to mark on it each cleat ſo that a perpendicular line, which would be drawn from the yard-arm at one of the cleats, ſhould correſpond to the tabling of its own reef. By theſe means it is evident as many ſuch cleats ſhall be requiſite at the end of each yard-arm (beſides that uſed for the bending of the ſail to it) as there will be reefs to the ſails. The reefs alſo ought to be marked, and the reef-bands placed gradually. Thus, when the laſt reef is taken in, it is neceſſary, and it will ſo happen, that the top-ſail will not be hoiſted more than a foot or two above the cap of the maſt, that the ſail may be diminiſhed by, at leaſt, one half, or two thirds of it: which manœuvre muſt be compriſed in three reefs for the top-ſails, and in one for the top-gallant, to which I ſhould like to have ſome put likewiſe, in order to make a more advantageous uſe of them when, in a ſtrong gale, one is obliged to carry them hauled lower down.

The ſtay-ſails ought, generally, to be triangularly ſhaped, and ſet in ſuch a manner that they ſhould not obſtruct the other ſails; as their uſe has been introduced only to fill up the vacancies in a cloſe-hauled ſailing. They are to be trimmed in ſuch a manner, that no wind ſhould be able to paſs between the maſts without meeting ſome canvaſs in its way. I have ſeen a top-ſtay-ſail trapezoidly ſhaped, which had two fixed clues; the one on the edge of the fore-

fore-top, between the two after treſſel-trees; the other upon a ſtrop a little above the frame of the fore-bell: ſo that nothing obſtructed the fore-ſail between the fore-maſt and the ſtay which came from the top to the bell. But, the foot tack of ſuch a ſail ought to be made moveable, that it may be trimmed ſharp when wanted.

The top and top-gallant ſtudding-ſails ought always to be triangularly ſhaped, that they may be eaſily manœuvered, and that they ſhould not obſtruct the top nor top-gallant ſails. When they are thus ſhaped, it will be proper to haul out their tacks before hoiſting of them; then, their haliards paſſing over the fore part of the top-ſail, you will hoiſt them behind that ſail. When you want to haul them down, you have but to looſen the haliard, weigh upon the down-haul tackle, which, like the haliard, is fixed to the head of the ſail, and is to go through a block placed towards the middle of the fore-yard at the diſtance of the fall of the outſide part of the ſtudding-ſail: then, with a piece of rope-band, you will furl the remains of the canvaſs on the end of the lower yard.

The lower ſtudding-ſails will moſt generally be of the parallelogram ſhape; and, for the ſake of their being more eaſily manœuvered in changes of winds, it will be proper to trim them on booms made with hooks.

After the ſails ſhall have been thus cut and completely made, it will be proper, the firſt time you put to ſea, to employ them for a week or a fortnight, in order to work them and make them ſtretch as much as the cloth, as well as head, leech and foot ropes, which are all new, will permit; then, taking them out, you will replace them with others to the ſame purpoſe, and ſhape them a-new, in order to make them, laſtly, as little concave as poſſible; for, it muſt be taken for granted that a ſail can never, at the firſt ſtroke, be cut to its proper and true form and ſhape, becauſe it always ſtretches as it wears.

II. It requires one to have but common eye-ſight to be convinced that ſails are never perfectly flat. But, every one is not perſuaded that the more extended is the ſail, the greater is the impulſion it receives from the wind which ſtrikes it perpendicularly, and the more effectually, of courſe, the ſail will afterwards act on the veſſel. It is a matter of aſtoniſhment to me how ſo many ſeamen are ſtill of opinion that a bag muſt be left at the foot of the ſail, to lodge the wind in; and how, to ſuch as propoſe to them objections againſt that cuſtom, they give for the only reaſon, that it is the feather which carries the bird off. This reaſoning is abſurd. A hauled-down top-ſail has got as much diſplayed cloth in it as when hoiſted up and well extended. In that ſituation, it forms by its convexity a very conſiderable kind of bag in which the wind may play at eaſe; and, notwithſtanding, it is obſerved that the rapidity of the ſailing decreaſes very much; whence we are to conclude that the power of the wind muſt have ſtrongly diminiſhed, ſince the ſail produces no longer the ſame effect upon the veſſel. Now, if you wiſh to enter into further particulars, and know demonſtratively the cauſe of that diminution in the impulſe of the wind, you have only to pay attention to the air which acts againſt the foot and the head of the ſail; and you will ſee that the wind, which ſtrikes at the head part, makes an effort to re-act towards the foot in the ſame manner as and againſt that which, having ſtruck at the ſame inſtant at the foot, endeavours to re-act towards the head. From this ſhock reſults (though the air eſcapes at each ſide) a compreſſion in the ſail. But, after having acted inwardly in the ſame manner as if it were ſhut up, it happens that it finds itſelf more and more compreſſed by that which ſucceeds to the firſt; and, though it eſcapes by the ſides, it is evident that it tries to extend, and that it impels conſequently, with an equal power, all the parts of the ſail perpendicularly; which is the cauſe of the ſail aſſuming the form of a circle's arc. Therefore, the ſail will produce no

greater

greater effect than if it had no other height but the ſpace contained between the two yards which ſerve to trim it: and I ſay that, rigorouſly ſpeaking, it may even not have that whole effect; for, that ſort of whirlwind, which is procured in the center by the re-action of the wind which ſtrikes its upper and lower parts at the ſame time, cannot fail diminiſhing the ſhock of the parts which, ſucceeding the former, would have ſtruck the ſail with all their primitive power; while, on the contrary, this power is now almoſt intirely deſtroyed by this barrier which oppoſes for a while their paſſage. To all theſe reaſons may ſtill be added, as a further argument, that the ſail having the form of an arc, there can be but very little wind capable to ſtrike it perpendicularly; for which very ſtrong reaſon it muſt, of courſe, have much leſs effect than another ſail, of the ſame height and width, which ſhould be very exactly ſpread every way.

I HOPE I have ſaid enough on this ſubject to obviate the oppoſite prejudice, and to engage every reaſonable ſeaman to direct his attention to the ſails of his ſhip, that they may be cut in ſuch a form as to preſent as flat a ſurface as poſſible.

III. THE center of effort of the impulſe of the wind, on the ſails expoſed perpendicularly to the courſe of the wind, anſwers exactly to the center of gravity of the ſurface which is ſtruck in that direct ſituation. But, as ſoon as you preſent it obliquely to the courſe of the fluid, and keep it ſo to it, the center of effort of the total impulſe will paſs on the weather ſide of its center of gravity; becauſe the particles of air, which at firſt met the ſurface, have been re-acted, and by the very act of their re-action they ſtop part of the paſſage to the ſucceeding ones, which diminiſhes of courſe both the ſtrength of the ſhock and the impulſe they would have given to the ſail, had not their movement been interrupted. But, this deviation of re-action in the firſt particles of air which have ſtruck, is repeated afterwards. For, all thoſe which ſucceed

them during the whole time the ſurface is kept obliquely to windward, continue to re-act to leeward: ſo that, from the firſt vertical line (taken from the ſource of the wind) out of all thoſe which form together the ſurface, there is a continual ſeries of obſtacles which change the ſhock of immediate and ſucceeding particles, and which alters it ſo much the more as they are to ſtrike the parts moſt to leeward of the ſail, and ſo much the leſs as they will ſtrike thoſe which are moſt to windward. Therefore, the leeward ſide of ſuch ſails as are obliquely expoſed to the wind is always leſs ſtruck than that which ſtands to windward. Hence it reſults that the center of effort of the abſolute impulſe of the wind on the ſail, is lodged in that weather-part of the ſail which is ſuppoſed to be equally divided in two, ſince that is the part which receives more impulſion. Therefore the ſame center of effort is alſo to the windward of the center of gravity of the ſurface; and the act of its removing from it towards the wind keeps pace with both the impulſe received by the weather ſide of the ſail, and that received by the lee ſide of the ſame ſail, and is in the ſame ratio. The truth of this aſſertion is continually demonſtrated by daily experience of ſhips at ſea. The ſails are carried by the yards and by the maſts, which divide them perpendicularly into two equal parts, from top to bottom, through their center of gravity, ſince they are of a trapezoid ſhape. When, being placed obliquely to the wind, they are left at liberty, without being confined by their arms or bowlines, they immediately range themſelves perpendicularly to the courſe of the wind, becauſe their weather ſide receives more impulſion than the lee ſide; and there they remain conſtantly, unleſs they are compelled to alter their poſition, becauſe all their parts are ſtruck equally, which keeps an equilibrium always among them; for, the power of the wind, whether it increaſes or decreaſes, acts always the ſame on them all.

This proof, which eſtabliſhes a wide difference to be made between the center of gravity and the center of effort in the ſails, requires

requires that a great deal of attention ſhould be paid to the uſe of that knowledge in the practice. For example, ſome ſort of cleats might be fixed in the middle and on the after part of the yards, which, in oblique courſes, puſhing them to leeward, would eaſe them out of the ſhrouds, and facilitate their bracing in carrying their center of gravity, as well as the center of the abſolute effort, to leeward; which operation would of courſe draw that center of gravity alſo nearer to the axis of the ſhip, from which it is ſo eſſential to remove as little as poſſible.

CHAPTER IV.

General Obſervations on the effect of more or leſs ſurface of ſails expoſed, in various weathers, to the wind.

I. WHEN a ſhip, under a certain ſet, or trimming, of ſails, has acquired the utmoſt velocity with the power which then puts her in motion, it is certain that, whenever the ſurface of the ſails is either increaſed or diminiſhed, the rapidity of the head-way will likewiſe augment or leſſen in a very complicated ratio. In order to find out the degree of impulſion of the wind on the ſails, you muſt multiply their ſurface by the ſquare of the exceſs of the velocity of the wind on that of the ſhip, or, which is the ſame thing, by the ſquare of the apparent velocity of the wind. Then, a ſecond multiplication of that product is to be made by the ſquare of the ſine of the angle of incidence abſolute, or, in the ſecond caſe, by the ſquare of the apparent ſine of incidence. Now, this ſecond product will give the degree of the abſolute impulſe of the wind on the ſails, in the actual ſtate which we have ſuppoſed.

IF you want to know in what ratio you are to augment the ſurface of the ſails, in order to make the ſhip acquire a certain degree of velocity above that which ſhe poſſeſſed under ſuch a particular quantity of ſail which you may ſuppoſe, you muſt firſt know by how

how much the velocity of the wind exceeds that of the ſhip: then, knowing by how many degrees you wiſh her to accelerate the progreſs of her head-way, you will increaſe the ſet or the trimming of the ſails in the ratio of the ſquares of the two velocities of the ſhip; *viz.* that which was known before the alteration of the ſails, and that which ſhe is to have acquired ſince. But, as the ſhip recedes ſo much the more from the action of the impulſe of the wind as her velocity increaſes, it is evident the ſurface of the ſails muſt be increaſed alſo in the ratio of the ſquare of the two exceſſes, I mean the different exceſs of the wind over that of the ſhip both before and after the increaſe of the ſails: then, the ſhip will undoubtedly acquire, by theſe means, the wiſhed-for velocity; provided, however, no other cauſe happen to oppoſe it, as we have already hinted before, and as we ſhall have an opportunity to ſhew more particularly hereafter.

SUPPOSE the wind has 12 degrees velocity, and the ſhip, under a certain ſet of ſails, has 3; the velocity of the wind, in the direct courſe, will exceed that of the ſhip but by 9 degrees. If, in this caſe, the velocity of the ſhip is wanted to come up to the third part of that of the wind, and take 4 degrees for her ſteerage or head-way; then the ſails are, to this effect, to be increaſed in the ratio of the ſquares of the two velocities 9 to 16, becauſe the oppoſition of the water on the prow will increaſe in that very proportion. But, in the firſt caſe, the velocity of the wind exceeded that of the ſhip by 9 degrees, while in the ſecond caſe it exceeds it no more than 8. Hence it reſults that the impulſe of the wind on the ſails has diminiſhed in the ratio of the two ſquares 81 to 64: and, in order to repair that loſs in the impulſion of the wind, the expanſion of the ſails is alſo to be increaſed in that laſt ratio of 64 to 81: then the ſhip will be able to run with the right degree of velocity which ſhe was wiſhed to have.

II. WHEN

II. When the maſting ſhall be perfect, that is to ſay, when the ſhip which is to be worked ſhall be maſted according to the *point-velique*, ſhe will riſe from the water parallel to herſelf by a certain quantity relative to her velocity, and that riſing will always increaſe more and more in proportion as ſhe will acquire new degrees of velocity in her head-way. The reaſon of this is, that ſuch a ſhip is moved by forces which ſtand exactly and continually in equilibrium with the action of the water on her prow, the forward inclination of which is ſo much the more contributing to that riſing out of the water as it is more remote from the perpendicular. For, then, the vertical impulſion muſt have more power, ſince it acts more directly on a very oblique prow than it would on a vertical one. With the ſame exactneſs, this reaſoning may be applied to the direct impulſion, the abſolute effort of which may be decompoſed, ſince it acts leſs againſt the velocity of the ſailing on an oblique prow than on a vertical one, while the other part of its action joins with the vertical impulſe to raiſe the head of the ſhip, which ſhocks the water with great ſtrength when ſhe is arrived to a very great velocity, a water which oppoſes her ſo much the more as it is ſhocked with a greater violence. So that it is eaſy to conclude that, in any ſhip whatever, the more rapid is the head-way, the more parallel to herſelf ſhe riſes above the water when the center of the effort of her ſails is at the ſame height as the *point-velique:* for, the point of the prow on which may be conſidered as united the action of the water which oppoſes its progreſs, may be taken alſo as that of bearing. So that all the ſails acting from aft to fore on various points of the axis of the ſhip, which herſelf may be conſidered as a lever in the directon of her length, they raiſe the after part of that point and place it on a level with the elevation of the prow; an operation which never can happen if the center of effort of the ſails is above or under the *point-velique*. If it is placed above, the power of the ſails, acting on too long levers, will raiſe the after

part

part of the point of bearing of the prow above the level of the elevation of the ſhip's head. If it is placed below, the power of the ſails, acting on too ſhort levers, the after part of the ſhip will remain plunged in the water without being able to riſe on a level with the prow. Therefore, in either of theſe two caſes, when the center of the effort of the ſails is either above or below the *point-velique*, however well-built a ſhip may be, ſhe will loſe ſome of her qualities, either in ſteering, or in her readineſs to obey the helm, or in ſhort in her ſteadineſs to carry her ſails, eſpecially if ſhe is overmaſted: for, in this laſt caſe, ſhe will gripe, incline eaſily, and loſe much of her head-way, ſince her prow will plunge in the fluid, or, which is the ſame thing, her ſtern will riſe too much out of it; which will diminiſh the action of the water on the rudder and increaſe it on the prow. In the laſt caſe, an inconveniency of which ſhip-builders ſeldom, if ever, have been guilty, the ſhip will be ſlow to obey, and her head-way will be ſlackened, becauſe ſhe will never be able to preſent her moſt advantageous water-lines to the fluid, nor have a ſufficient ſurface of ſails, as, although their width is the ſame, their perpendicular length is not ſo. Hence we muſt, therefore, conclude that the true point of perfection to be aimed at and obtained is only this, *viz.* when the center of effort of the ſails is placed at the height of the *point-velique*.

III. I AM now going to lay down a propoſition which will appear a monſtrous paradox to many ſeamen. But, it ſeems to me too ſelf-evident a truth to refrain from promulgating it; eſpecially as it can be oppoſed but by mere habit and cuſtom; and, indeed, ſuch motives are little worth being regarded.

I MAINTAIN that there are many caſes in which the adding of a few ſails, inſtead of increaſing her velocity, poſitively retards a ſhip's head-way. It is notwithſtanding an error in which all ſeamen almoſt continually fall into, when, in a ſtrong gale, they want either to recede from, or approach, a ſhip they want to avoid or chaſe.

When

When their ſhip is arrived to a very great pitch of velocity (ſometimes of twelve and more knots an hour), if they have to do with an adverſary the rapidity of which is nearly equal to that of their own ſhip, they fancy that, by adding more ſails to thoſe they have already, at the time when their ſhip is perhaps beſt diſpoſed and arrived at its utmoſt degree of ſwiftneſs, they will increaſe the rapidity of her head-way; and, accordingly, they hoiſt up ſome additional ſtay or ſtudding ſails, eſpecially if the wind happens to be on the beam or a little more aft. But, there happens then quite the reverſe of what they expected; for, the ſhip becomes more inclining, her head plunges, and, the reſiſtance of her prow increaſing in the direction of the keel more than the effort of the ſails in the direction of the head-way, the rapidity decreaſes in ſo much as the water acts more powerfully than the ſail does relatively to the obſervations we have juſt made. Beſides all this, thoſe forward and lateral inclinations of the ſhip, produced by the effort of the new-added ſail, which have cauſed the center of effort of the ſails to aſcend, and the *point-velique* to deſcend (if the new-added ſail has been ſet above it), cauſe alſo the ſhip not to riſe from the water parallel to herſelf; ſhe riſes her ſtern and plunges her head; whence it reſults that ſhe becomes griping from two cauſes: firſt, becauſe, as her ſtern lies leſs in the water, the rudder is of courſe expoſed to a leſs ſhock; and the ſtern, which always acts as good as any ſail, is more eaſily maſtered by the wind which ſtrikes it then on the beam with a great deal more efficacy than it does her head; on the other hand, as the lateral part of the reſiſtance of the water on the leeward part of the prow has been increaſing by the inclining of the head, which has plunged that part of the ſhip which is the moſt ſwelled and bellied in its careen, and thereby increaſed alſo the ſurface on which the water acts, which has both diminiſhed the head-way and increaſed at the ſame time the lateral impulſe on the ſide of the prow; ſo that lateral impulſion forces the ſhip to windward more at the head, than ſhe is impelled to fall off by the lateral

part of the effort of the new-added ſail. Whence it follows that the ſhip becomes ſtill more griping, which is an additional cauſe of her head-way's decreaſe; becauſe, the helm of the rudder being more a-weather in order to keep the ſhip more on her ſtanding on, a great deal more of the rudder itſelf is offered to the run of the water, by the great ſurface it offers more directly to its ſhock; and, by ſuch means, oppoſes the current of the water-ſtreams, and retards the velocity of the ſhip. Whence we are to conclude that as ſoon as any more ſails are added to a ſhip which carries already a ſufficient quantity of them, ſhe will loſe her qualities of ſteering well and making a good head-way through the water: whether thoſe additional ſails are ſet forward or a-ſtern, it is indifferent; they will always be equally noxious and detrimental.

CHAPTER V.

Particulars to be obſerved in the fitting-out of a ſhip, in order to accelerate the execution of it.

WHENEVER celerity is required in the buſineſs of fitting-out a ſhip for the ſea, order muſt be introduced in the diſpoſition of the different branches of that operation as well as in the attending cloſe the execution of them. So that, when you have once begun a certain particular object, ſuch as rigging, ballaſting, or ſtowing, &c, &c, &c, you muſt attend it cloſe till it is finiſhed, before you attempt another which, in its turn, muſt likewiſe be attended the ſame.

AMONG the various operations which are to be executed in the courſe of the equipment, there are a few things of mere obſervation or detail, which may be either prepared before-hand, or ſo diſpoſed as to be ready for the time it will be proper to ſet about them. Accordingly, you have only to ſelect a ſmall number of ſailors, or other workmen, ſuch as are known to be the moſt aſſiduous and ſkilful, under the command of an intelligent mechanical officer, and

theſe

theſe people will forward the preparations without its being hardly perceived; ſo that, when you come to ſet about the buſineſs for good, every thing goes round and eaſy, without being ſtopped at every inſtant by a thouſand minute particulars.

The officer on duty, or charged with the inſpection of the works, will report to the Captain in the evening every thing which ſhall have been done in the courſe of the day, and agree at the ſame time on what is to be done the next. When this is once agreed on and ſettled, the order muſt ſtand good and ſubſiſt without its being allowed or permitted to be interrupted at any time during the courſe of the work, unleſs ſome unforeſeen accident and of great moment ſhould happen.

We muſt remain intimately perſuaded of this truth, *viz.* that it is always attended with the loſs of a vaſt deal of time when we are obliged to paſs on a ſudden from a buſineſs begun to another which is juſt ordered, and then to quit this to paſs again to a new one or to return to the firſt. This buſy uncertainty alone puzzles the workmen, and diſguſts the very leaders themſelves of the works; and the want of order can never produce but dilatorineſs in the execution of an operation, let it be whatever it will.

I am not unaware that more than one object may ſometimes be undertaken at once; and I even adviſe to put it in practice whenever there will be any poſſibility ſo to do. But, I nevertheleſs return to my firſt principle laid down, that all works begun ought to be conducted to their end, without interruption, by the ſame hands as undertook them, before thoſe hands are put about any other ſort of buſineſs.

One muſt ſeldom ſet about doing any kind of buſineſs, when every thing is well ordered, unleſs one is morally ſure of being able to bring it to concluſion without any interruption. It is a general principle that no mariner is allowed to be ignorant of. There are notwithſtanding ſuch moments and intervals of labour which are not to be waſted. In theſe circumſtances, the hands are to be ſet about

certain preparations or certain ſmall operations relative to works one foreſees or knows to be ſoon undertaken. It is at ſuch times activity is not to be abated, nor any hand ſuffered to remain unemployed; for, if inaction and idleneſs is once ſuffered to lay hold of them, it can in the end but make them weak, ſlothful, indolent, and effeminate.

CHAPTER VI.

Of the careening and ſcupper-nail-ſheathing of ſhips.

I WILL not attempt to give here an account of all the particulars concerning the diſpoſitions neceſſary for, or the act itſelf of, heaving down a ſhip in order to careen her. Seamen are ſo well verſed in theſe operations, and they are ſo ſimple and ſo eaſy to be conceived by thoſe who never have ſeen them done, that it is better to refer people to experience than to undertake here a deſcription of the ſubject. But, we ſhall make it our buſineſs to deſcant on what might beſt be done for the preſervation of ſhips and preventing them from being worm-eaten.

It is a great while ſince the means have been ſought for to prevent worms from eating the wood, lodging themſelves in it, and boring it, as they do, in all the ſhips which have gone long voyages, or which remain in harbours and roads the ground of which is oozy and fit to produce, or favour, thoſe gnawing inſects. Every thing which has hitherto been attempted in that reſpect has proved unſucceſsful; and nothing but the nail-ſheathing has been yet known capable to preſerve the ſhips from that accident. Therefore, we will direct our thoughts to that ſort of expedient of ſheathing ſhips; but we propoſe to improve upon it, and to adviſe to do it a new way: for, I am fully convinced that the preſent method of doing it, which is by covering the bottom with ſcupper nails, is very defective, for the following reaſons. As the ſurface of a ſhip's bottom is very uneven, the head-way of a ſhip, thus ſheathed with nails,

nails, decreaſes very much, owing to the increaſe of reſiſtance of the fluid; the firſt objection. The ſecond is, that if the ſhip happen to leak, either through the looſeneſs and play of ſome of her parts, or through the want of oakum, which rots in time, within the ſeams of the planks, you muſt loſe in the careening all the ſheathing and the nailing, which is attended of courſe with a great additional expence. And a third objection is, again, that it often happens a ſhip comes out of the harbour quite tight and dry, and is no ſooner offward but ſhe leaks, becauſe the labour of the parts which are covered with the nails occaſions, frequently, the ſcarfs to give way.

To remedy, therefore, all theſe inconveniencies, I would propoſe to ſheath the ſhips with nails on the free planks of their bottoms, and to employ for that buſineſs nails one inch and an half long, with heads at leaſt one inch diameter, and nearly like thoſe which ſerve to faſten the iron bands on the waggon wheels. Such nails ſhould be placed alſo in ſuch a manner as would admit of two or three lines diſtance between each nail's head, ſo that the ruſt might communicate from nail to nail and occupy all the diſtance between them; for, ruſt is the only thing which really prevents the worms from getting into the wood. And, in order to remedy the unevenneſs of the bottom's ſurface, it will be proper to make with a gouge a cavity in the plank of the ſame depth as the thickneſs of thoſe nails heads, that they may be ſunk in it and thereby appear on a level with the ſurface of the wood.

On each ſcarf, or on each plank's end, I would alſo have two iron cramperns, with pikes, vertically placed, and ſo incruſted into the wood as not to appear above it. All this being done with care, and the ſhips being next well caulked with the horſing-iron, ſo that the ſeams be as narrow as poſſible, you will pay the whole bottom all over with a liquid pitch, this ſpecies of brown coat being preferable to the paler ſort, as it ſticks better.

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THE advantage which will reſult from that mode of careening ſhips will take leſs time in ſheathing, and will render careening itſelf more eaſy; beſides, it will facilitate the viſiting and examining of the ſhips, whenever it may be found neceſſary, without being ſtopped in the operation by the ſheathing or the nails: there will be no need of employing ſo many carpenters; in ſhort, in the Colonies, the expence will be found much leſs than it is now.

ONE might again, after the method of the inhabitants of Surata, build and careen ſhips ſo as to laſt a hundred years, by paying their bottom all over, and even on the free planks, with a coat of *galgalle* * well-made after their own way, and the ſeams covered with *ſarangouſti* †.

IF you want abſolutely to ſheath your ſhips, it will be better to do it with ſheets of copper as thin as paper. The Engliſh have tried it, and it has ſucceeded. The firſt expence will appear coſtly, but that copper is melted a-new for each careening. It is to be obſerved this ſort of ſheathing never becomes foul, and muſt be nailed with copper nails, becauſe the iron ones becoming ruſty would all fall off.

CHAPTER VII.

Of the ſcantling in men of war, and in general of the ſtrengthening-pieces.

THIS is a ſubject for the general cry of all the Navy, and not the leaſt reaſonable is it I muſt confeſs.

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* *Galgalle* is a compoſition of oil, quick lime, and oakum, mixed together, with which they grave and pay a ſhip's bottom in India.

† *Sarangouſti* is a kind of maſtick, ſuperior to any other, uſed in India for the purpoſe above mentioned.

They have of late years built exceeding good veſſels, and they continue, it is true, to build ſuch now; but I cannot help obſerving that thoſe ſhips might ſtill be improved in their form. After having blamed the exceſs of height in the maſting of ſhips, I think myſelf authoriſed in pointing out the defects of their ſcantling: and I think I am ſo much the better grounded in doing it, as it is from a perfect knowledge of the error, that I embrace this opportunity to reprobate it.

It muſt be allowed that the ſhips which are built now on the modern principles are in every reſpect ſuperior to thoſe of former times; they are undoubtedly learnedly built. But, nevertheleſs, if they go on much longer on the plan they have adopted, it cannot be denied but they will ruin Government at laſt by the ſhortneſs of their duration. They cannot ſtand an action as long as our old ſhips uſed to do, through the body of which the bullets formerly did not paſs, but remained in the planks. Experience has ſufficiently proved it, and the *Tonnant*, an old ſhip, ſhews it ſufficiently to all the Navy, while thirty others of the modern conſtruction witneſs at this time, in every part of the world, that there is not one of them but may be pierced at the water-line by a twelve-pounder. A diſadvantage which might eaſily be remedied, if, inſtead of giving them 17 or 19 inches ſcantling perpendicular to the lower battery they had 24 or 28; and if, beſides, they were built full of wood from eight feet lower than the water-line up to the ſecond deck, as it ſhould inconteſtably be in ſhips which are deſtined to carry twenty-four and thirty-ſix pounders, and to fire in line. A ſhip thus built will have undoubtedly a great advantage in cannonading over a thin ſhip expoſed to be pierced through and through at every broadſide ſhe receives, and who cracks in ſhivering under the iterated concuſſions occaſioned by the quick firing of her own artillery. On the other hand, theſe kind of veſſels, thus ſtrengthened, might be made tighter than the others; becauſe it would be eaſy to faſten their ſeveral parts one upon another with iron ſcrews, beginning at one end

end and continuing thus to the other. The timber-work holding in this manner all together, could not eaſily labour in one place without being ſupported by the remainder: ſhould two parts tend to divide, they could not do it without breaking ſeven or eight ſcrews, and without forcing upon the other neighbouring parts. When ſuch a ſhip would come to board another of a weak ſcantling, whatever might be the weather or ſea, ſhe would preſent her a maſs, which, without being of a much larger ſize, would be of a very different ſolidity, a ſolidity which would ſave her from ſuffering ſo much as a weak veſſel, all the parts of which play if ſhe is ever ſo little hurt, as ſeamen have many a time experienced it, in ſundry ſimilar events of this kind, and as it is eaſy to verify it whenever we navigate modern ſhips which are weak, not only through their ſcantling being unable to ſtand its own iron-work, but alſo through the fault of their interior ſtrengthening-pieces, and the great diſtance there is between a broad thin beam and another, and the over-weakneſs of theſe ſame beams, which being neither thick nor wide enough are not capable to ſupport the fore-caſtle nor the quarter-deck, on account of the weight of the iron artillery with which the men of war are obliged to be loaded. So that, after a campaign of ſix years in the Colonies, and ſometimes leſs, theſe veſſels are at their return home expoſed to be rebuilt or condemned. The ſame happens with the flutes or ſtore-ſhips, the ribs of which being all looſe, leak every where, between decks and the hold, as ſoon as they are toſſed about by a heavy ſea, which, in a ſtrong gale, they very often ſhip by over the waiſt.

If they thought to get much in the building of ſhips by the lightneſs of their weight, they have certainly ſucceeded to admiration in that reſpect. Notwithſtanding, I believe that, if naval architecture had received no other improvement but this, we ſhould be ſtill expoſed to be bleſſed with no better than hawkers little fit to go with rapidity from one place to another, and to manœuver in preſence of the enemy. For, it is evident that a light ſhip, made

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on the ſame pattern as another more heavy, has no better diſpoſitions to divide the fluid than the other, ſince ſhe offers the ſame ſurface, and ſhe has the ſame quantity of water to overcome, being both obliged to take a ſufficient and proportional quantity of ballaſt in order to ſink both equally to the ſame water-line. Moreover, how much more do you think the heavieſt-built ſhip will ſink into the water on account of its greater quantity of wood? Two or three inches only, and no more. For, ſuppoſe there ſhould be in the conſtruction of the one about thirty or forty tons of wood and iron more than in the other, any one may take notice that when ſuch a ſhip (which I ſuppoſe to be a ſeventy-four or eighty gun ſhip) is ready to take the ſea, forty tons more or leſs will not be capable to make a difference of two inches in its ſinking. Beſides, the ſize of the veſſel may eaſily be increaſed in the ſame proportion as the weight of wood and iron which will be ſuſpected to enter in her conſtruction, without its being any way detrimental to her good quality, whenever ſhe ſhall be commanded by an able Officer, who will know how to manœuver his ſhip to the beſt advantage. Such was and is ſtill the ſhip *Comte de Provence*, built at Port l'Orient by Mr. Coulon. This ſhip has been the admiration of all the mariners who have ſeen her navigate, either alone or in ſquadron. At ſix feet under her lower deck ſhe had all the good qualities which can be wiſhed for in a ſhip of the line; at ſix feet eight inches, ſhe loſt none ſtill. The only fault one has been able to reproach that unparalleled ſhip with, is the weakneſs of her ſtrengthening-pieces and of her ſcantling, which was but nineteen inches thick in the middle of her lower tier perpendicular to her ſide, with too much room and ſpace between her ribs; ſo that eight pounds ſhot pierced her through and through, even in the gangway of the orlop. That ſhip, ſay they, would have loſt ſome of her good qualities, had ſhe been ſtronger in her ſcantling as well as in her ſtrengthening-pieces. But, what an effect, I ſay, could forty tons have produced on ſo conſiderable a careen?

AGAIN; ſhould one be afraid, in the preſent ſituation of things, to increaſe too much the weight of the upper works, it is eaſy to take part of that weight away from the height of the dead works. Five feet two inches height between decks under the beams, for ſuch ſhips as carry thirty-ſix pounders, are full ſufficient to ſerve the artillery with eaſe. (Care alſo may be taken, by the bye, to garniſh the part above the vents of guns with only tin plates.) Now, five feet for the height of the gunwale, and a little more than that aft, under the quarter-deck, will certainly do very well. Next, let there be on the poop neither ward-room nor cabin, that is to ſay, neither top-gallant poop nor poop-royal, and let every thing elſe thus be proportionally diminiſhed which belongs to the upper works; it will ſoon be eaſy to get back that way what might have been loſt on the other: for, the artillery of the ſecond deck, as well as that of the forecaſtle and quarter-deck, will be a little lower, by which means the center of gravity will perhaps have lowered rather than it will have heightened through the increaſe of wood and iron. After all, the builder cannot evidently fail, in calculating his plan, to know to a tittle what he can get or loſe in reſpect to the qualities of his ſhip; and that will be a trouble attended rather with expence of time than with difficulty.

IT will be again very eaſy to diminiſh the top weight by the mode of rigging, as we ſhall ſhew it hereafter. On the other hand, there will be likewiſe a poſſibility of lowering the center of gravity in not taking on board to ſea ſuch a quantity of uſeleſs anchors, which only fatigue the ſhip; two of them are ſufficient there. The others may be placed in the hatchways, and their ſtocks between decks, ready to hoiſt up at the approach of land. In ſhort, there are a thouſand ways to lighten the upper part of ſhips, and to ſtrengthen them in their timber, without expoſing them to loſe any one of their good qualities.

THE lives of the men, which one ought always to have in view to preſerve as much as poſſible, is an object of the firſt conſideration

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and importance. It is clear, from what I propoſe here to do, that the gunners who ſerve the artillery will not be ſo much expoſed in the battering of a ſhip, the ſcantling of which will be ſtrong, as in thoſe of the modern ſhips; for, very few bullets will be able to get through her ſides. Theſe men will therefore be able to reſiſt longer againſt ſuperior forces, and to ſtand with more advantage againſt equal ones; and eſpecially at this time when boarding is no longer practiſed, and all its advantages unknown; when long, tedious and ſlaughtering cannonading is preferred to coming to a ſhort, deciſive and more courageous way of fighting, which is at the ſame time infinitely more ſuitable to the temper and natural vivacity of our Nation, which has not the phlegmatic coolneſs of her competitors in that mode of fighting. In ſhort, let us render our men of war ſtronger, and they will gain by it in action: let us render our *flutes* or ſtore-ſhips more ſolid, and they will be more fit for trade.

The ſhips may be ſtrengthened in their length by making what are generally termed the *ſtrengthening-pieces* ſtronger than they are now uſually made; by indenting, beſides, the deck-planks with two more, one of which on the beams, like the binding ſtrakes; and by making the decks ſtrait from one end to the other without any ſheer, and the beams likewiſe without any rounding-up or convexity. It will be eaſy to give them that degree of convexity neceſſary for the water to run off, by adding a piece of wood on the middle of each beam, cut in ſuch a manner as to make it a ſegment of a circle, over which the planks will be fixed. One may again in the holds place ſome iron bars acroſs, in form of buttreſſes, four inches ſquare, which will prop arch-like in croſſing each other from the top of the ſtanchions, which carry the weight of the deck, to the foot one of another. Such a contrivance would prevent the play of the whole machinery in general, by the ſtrong oppoſition it would make to the top part weighing down, without obſtructing in the leaſt the ſtowage. It will be proper to join the

quarter-deck and forecaſtle together, and to leave between the gang-ways only the ſpace neceſſary for the paſſage of the boats; which will give two rows more of binding ſtrakes from one end of the ſhip to the other. Such binding ſtrakes might again be placed from one end of the ſhip to the other on each ſide of the ſtanchions, riſing five or ſix inches above the decks in order to augment the ſtrengthening the length-way without obſtructing the guns. All theſe additions of wood and iron works will perhaps render the whole maſs more heavy, eſpecially if care is not taken to do as we ſaid before; I mean, to take off one way the weight that is added the other, by diminiſhing the lading. But, as the qualities of a ſhip depend but upon her ſhape, more or leſs advantageous for ſailing, ſteering, carrying her ſails more or leſs ſtiff, &c, and on the perfection of the trimming of her ſails with reſpect to the various impulſions to which ſhe is expoſed; it is evident that more or leſs maſſiveneſs in her can have no influence over thoſe qualities, ſince in both caſes the quantity of water ſhe is to diſplace is the ſame, as well as the reſiſting impulſe, ſince the water-lines at the prow are alſo the ſame in every circumſtance. I go ſtill farther: let the outſide of the outer beam be increaſed in thickneſs equal to that which will be added to the ſides of the ſhip, and let the length abſolute of that beam be four or five times that addition in the ſtrength of the ſcantling; all that put together will never come to ſix or eight feet in the ſeventy-four gun ſhips, becauſe their additional width will not be more than ſixteen or twenty inches, which will not alter in the leaſt the center of gravity; but the volume of water ſhe is to diſplace will be more conſiderable, in proportion, than the total of the weight added to the ſhip; whence, conſequently, her ſolidity will be increaſed alſo, as well as her power to carry her ſails, without loſing the leaſt advantage of her water-lines, which will always have the ſame fine of incidence with the meeting of the fluid; a truth which it would be eaſy to prove to a demonſtration.

CHAPTER

CHAPTER VIII.

Of the houſing-in of the top-timbers.

THE houſing-in of the dead works in men of war is ſo conſiderable, that the guns of the ſecond tier or deck have hardly room for their neceſſary recoil between the long-boat and the board: ſo that one is obliged to put the ſpare top-maſts on the gallows bits, where generally they ſeldom fail being ſoon cut to pieces by the ſhot. And, if they happen to be thus treated during an action, they fall on the deck when the gangways are not cloſe to the boats. Then they encumber the guns in ſuch a manner as to make it impoſſible to uſe them for a good while. The Officer who commands the battery, and thoſe above who occupy various ſtations, find a deal of trouble to go from one end to the other to give orders and to attend to every thing. That fact is well known; nor are the builders without foreſeeing it in their conſtruction: but, as they themſelves do not get on board, they are not ſenſible enough of the abſolute neceſſity of allowing ſo much more room as what they are wont to do. There have, notwithſtanding, been able builders who have built exceeding good ſhips with very little of what they call *tumbling-home*; for, this mode of building adds nothing to the qualities of a ſhip; but they have not made any proſelytes, and that form ſo preferable to ancient practice has not yet got the better of the old way.

THE Regulations on Cruizing, publiſhed in 1757, encouraged boarding, while in all the ſea-ports of France all the builders ſeemed to have made a compact together to build frigates and men of war with ſo much houſing-in that it was next to impoſſible to execute boarding, as there was a ſpace of ten or twelve feet to leap over between the waiſts of the two ſhips faſtened together with grapnels, a circumſtance which adds again a new difficulty to the boarding

boarding by the perpetual and inceſſant motion of the ſhip it occaſions in rolling and pitching. Was there no oppoſition or defence to be met with on the ſide of the ſhip attacked, one might perhaps find means of boarding her, and yet it would not be without trouble: *à fortiori*, when, inſtead of being able to ſtretch the hand one to another, one is received with ſwords and piſtols, and ſo many other ways which are made uſe of to repel the enemy, and render it impoſſible to ſucceed in that attempt. That way of houſing-in muſt therefore be diminiſhed as much as poſſible, in order to facilitate that mode of fighting which of all is the moſt advantageous and the leſs ſanguinary.

If little or no houſing-in comes to be given to the frigates and men of war, then it will be very proper to increaſe alſo the ſtrengthening-pieces in the direction of the length; by which means their artillery will become more at a diſtance from the axis, but not more above the center of gravity. The ſhip will therefore poſſeſs the ſame quality of carrying her ſails very ſtiff: ſhe will poſſeſs that other alſo of rolling more eaſy, and not ſo hard as, through that immenſe weight of the artillery of the upper deck, quarter deck, and forecaſtle, ſhe did before; and which, being now carried on each ſide of the point round which the balancing is made on levers which have increaſed in their length by all that which has been diminiſhed of the tumbling-home of the top timbers, will enable her of courſe to oppoſe better the motion, ſince ſhe will form larger arches. Therefore, there is nothing poſitively to loſe, and on the contrary a great advantage to gain, by the diminution of that trimming home; for, the ſhip will preſent a wider ſpace for engaging, ſhe will roll eaſier, and her maſting will be better ſupported; advantages which are various, and on the reality of which there is no reaſon to doubt.

In the extreme and utmoſt inclination poſſible (ſuppoſing that a veſſel well-built and well-ſtowed ſhould ever be liable to it) the

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ſhip which ſhall have no houſing-in will preſent a greater and greater ſurface to the water in proportion as, in heeling, ſhe will get deeper and deeper into it: ſo that the direction of the vertical impulſe of the water will always be above the center of gravity of the ſhip in cutting the line on which it is placed with the metacenter. By this mean the effort of the water will always ſet the ſhip up again, however inclined ſhe may happen to be; a property which no other ſhip with a great houſing-in can ever poſſeſs; for, if ſuch a one, in coming to heel, ſhould ever come to paſs her extreme breadth, then the vertical impulſe of the fluid ſtrikes her under her center of gravity, and compels her immediately to overſet.

I WAS once in a large veſſel which had but little houſing, but which, on the other hand, was in every reſpect ſo badly built, that I may well ſay ſhe had no other quality but that of being able to take a large cargo. She inclined eaſily, though (very luckily for her maſting) ſhe was ſo large. One day, among others, as we had all the ſails out, we were caught by a violent gale which turned us on a ſudden on our ſide, even ſo much that the guns of the lower deck went to the water, though they were ſtill nine feet higher than the level of the ſea, which was at that moment as ſmooth as a glaſs on the weather ſide. We remained above twenty minutes in that diſtreſſing ſituation, from which we were not relieved but by the loſs of almoſt all our ſails, which were carried away by the violence of the wind. Had that ſhip had much houſing-in, with ſuch an inclination of near thirty-five or forty degrees, there is not the leaſt doubt but ſhe would have turned clean over: for, if her center of gravity was high, the metacenter was a great deal more ſo ſtill, ſince the water always met with more ſwelled parts which oppoſed it; but if ſhe had notwithſtanding carried her heeling beyond her ſwelling and as far as her houſing-in, which was very high though of very little depth, it is moſt likely it would have been attended with worſe conſequences for us.

CHAPTER

CHAPTER IX.

Of the ballaſt and lading.

WHEN a ſhip is in lading, one muſt firſt admit of the truth of this principle, *viz.* that the ſoftneſs or hardneſs of the rolling and pitching depends not altogether ſo much on her ſhape and form alone, as on the more or leſs advantageous diſtribution of the heavieſt parts of her cargo.

THE moſt particular attention, for example, is to be paid to the moderating of her pitching, as that is what fatigues moſt a ſhip and her maſting; and it is moſtly in one of theſe motions that maſts are ſeen to break, particularly when the head riſes after having pitched. Although the rolling be proportionably more conſiderable a movement than pitching, it is but ſeldom any accident is ſeen to ariſe from it, as it is always a ſlow one. Notwithſtanding it is not leſs proper to prevent it as much as poſſible. This will eaſily be obtained, without being any way detrimental to the ſhip's ſtiff carrying of her ſails, if, when the ballaſt is in iron, you ſtow it on the floor-timber's ſcarfs; becauſe it will recall the ſhip with leſs violence after her having inclined, and will act on a point a little diſtant from the center of gravity. It will be proper to obſerve likewiſe not to make it aſcend too high on each ſide of the ſhip, and to fill up the vacancies which are between the firſt and ſecond plank of the wood ballaſt, then to ſtow the remainder ſmooth and even. Next to this, when all the ballaſt is well diſpoſed round and under the center of gravity of the ſhip in the form and manner juſt laid down, and drawn a little (that is to ſay, between 20 and 30 feet) fore and aft that point, ſo that the ſhip ſhould find herſelf juſt at the draught of water marked by the builder, you will ſtow over it in a ſolid manner the cargo, in obſerving to begin by placing firſt and at the bottom the loads which are moſt heavy and capable to ſuſtain the weight of thoſe which are to be ſtowed over them.

We place the ballaſt round and very near the center of gravity of the ſhip, becauſe it will prevent the motion of the pitching being ſo hard as it would, were that weight more diſtant either afore or abaft that point. Whenever the ſea runs a little high, the ſhip is never carried by a ſingle wave; there are two or three always paſſing under at the ſame time, unleſs it is when the ſea is extremely long and the ſwells come from a great diſtance, and in latitudes vaſtly remote from land: for, then, it happens that the largeſt ſhips are ſometimes carried by one ſingle wave. But, in either circumſtance, I maintain the ballaſt ought not to be ſtretched afore or abaft the center of gravity, as ſoon as the ſhip is in the parallel to her draught of water marked for the ballaſt, which it is abſolutely eſſential to pay great attention to. To prove what I lay down here as a principle, I will ſuppoſe in either caſe a long or ſhort ſurge, and that the water comes and hits the ſhip afore, that thereby ſhe may be conceived as expoſed to the circumſtance of the greateſt and ~~hardeſt~~ pitching, as I myſelf have experienced many a time: for, in this caſe, when the wave takes the ſhip under the ſtern, her motions, if ſhe has got a little head-way, are not dangerous; becauſe, as ſhe flies before the wave, ſhe recedes in ſome meaſure from its impulſe; while, in the other hypotheſis, ſhe increaſes on the contrary that ſame impulſe in the ratio of the ſquare of all her velocity.

First, the ſhip whoſe extremities are light or leſs loaded, being ſuppoſed to run with any velocity whatever againſt the wave which comes to her a-head, ſhocks that wave undoubtedly with a force expreſſed by the ſquare of the ſum of the two velocities: ſhe divides it and goes through it at the ſame inſtant as ſhe is raiſed by the vertical impulſe of that column of water which oppoſes her a weight more conſiderable than is the diſplacing of it: the wave which follows produces the ſame effect in receiving the fall of the ſhip, becauſe the firſt is already under the middle of the ſhip,

whence it paſſes to the ſtern, which is ſupported by it, while the ſecond has already taken its place in the middle, and the third is come to ſupport the head by a continual and uninterrupted ſucceſſion of waves. This motion continuing thus as long as the ſea is in agitation, it follows the ſhip is never at reſt: no ſooner has ſhe been raiſed by a wave, but ſhe falls again when that wave is gone, which falling is proportionably leſs ſharp as her head is leſs heavy: the ſhake is then leſs violent, ſince ſhe ſhocks the water with a leſſer maſs, which prevents her pitching ſo deep as ſhe would, was ſhe more heavy; conſequently, the maſting does not ſuffer, and the velocity of the ſteering is leſs delayed, as the moſt ſwelled part of the prow is not ſo much expoſed to the ſhock of the water.

Secondly, when the ſhip is carried by one ſingle wave, it ſtands to ſenſe that her fall is ſtill leſs ſharp, if little loaded a-head, when ſhe is no more carried but by the middle. She riſes, therefore, more eaſily at the moment the other wave comes to meet her, and the ſhake is not ſo violent. Was ſhe to plunge deeper into the fluid, it might happen that the column of water would be higher than her head, and, paſſing partly over it, would expoſe her to the imminent danger of foundering.

REMARK.

In the ſtowing of the cargo, it is proper to place the heavieſt part of the ſtowage as low as poſſible, and to take care to preſerve the draught of the ſhip which is moſt advantageous for her qualities, whether on her ballaſt or when laden. Thoſe points are marked both at the head and ſtern; and they ſhould be ſo likewiſe in the middle, in order that one ſhould not be expoſed to deviate from the water line and from that ſituation of the ſhip which is moſt favorable to every thing which may be required of her, as ſhe muſt be placed in the ſituation moſt advantageous for dividing the fluid, and to behave well at ſea in all kinds of weathers. In a word, the great art of ſtowing, lies in endeavouring that each of the vertical

parts

parts, in which the extremities of a ſhip may be ſuppoſed to be equally divided, be lighter than the weight of the maſs of water they are to diſplace; and ſhould the penetration of any one be ever ſo weak, it is impoſſible not to diſcover a multitude of advantages in it. We are not to forget, however, to take notice that the vertical parts of the middle admit of being loaded heavier than the weight of the volume of water they are able to diſplace.

CHAPTER X.

Of the rigging in general.

THE art of rigging ſhips is the higheſt pitch of ſkill in the ſea Officer and in the ſailor. Therefore it is a kind of knowledge too eſſential to be diſpenſed with by the Officer; for, the rigging not only ſerves to ſupport the maſts, but alſo to manœuver the ſails, ſince at every moment it ſerves to diſpoſe of them one way or the other, in order to give the ſhip the various motions which are requiſite. It is therefore indiſpenſably neceſſary to have a perfect knowledge of the rigging.

MANY Officers are thorough maſters of that buſineſs, but none have yet turned their thoughts to the reform which this branch of the manœuvre is ſuſceptible of, for the beſt. This is, therefore, preciſely what we are going to undertake here, in treating of this ſubject at large, and without entering too minutely into particulars.

THE diminution of weight and bulk will be our principal object, perſuaded that both the one and the other are inconveniences very unfavourable to the qualities of a ſhip.

THE firſt thing which I would, therefore, remove in the rigging, is that prodigious quantity of ſervice which is employed about every thing and every where. The ſheets and tacks of the courſes, as well as thoſe of the top-ſails and their tyes, are ſerved and parcelled in ſuch a manner that, through that abuſe, they are generally a quarter bigger than the rope with which they are made. So that,

when you come to haul aboard ~~or tally~~ the tacks or the sheets of those ſails, the friction becomes ſo conſiderable, and ſo hard, that it is not without the greateſt pain and labour you execute it. If theſe ropes, which I could wiſh always to be ſingle, with reſpect to the lower ſails, and without any other block on the clue of the ſail than that of the clue-garnet, were ſerved but at three feet diſtance from the clue, they would not be inferior in point of goodneſs for it. The ſerving of a rope does not ſtrengthen it; it is uſed only to prevent its being chafed in the block through which it is reeved: therefore, ſhould theſe ropes be ſerved no more than we ſay, they would be ſtill ſufficiently ſo; ſince there is but one point of them which is to reſt on the ſheave. As for the ropes of the lower ſails, their reſting point is inceſſantly changing, as they are veered away more or leſs, according to the ſituation of the tacks and ſheets* they belong to, and which ſhould always be ſingle; for, if they are employed double as cuſtomary, they are nevertheleſs always ſingle on the ſheaves, which, after all, comes ſtill to the ſame point, with reſpect to the power of reſiſting.

The tyes of the top-ſails are nothing more than running ropes, which are to be ſuch as to admit of being eaſily reeved in the blocks: therefore they muſt by no means be ſerved, unleſs they be fixed and faſtened on the yard: and, in that caſe, it will be proper to ſerve them about the length of three or four feet from the yard. The ſame may be ſaid of the ſheets and tyes of the top-gallānt ſails.

The ſhrouds and ſtays ought abſolutely to be ſerved no where elſe but at their collar and catharpings; the ſtrops and pendants, of all denominations, at their collar only.

In men of war, as well as in any other kind of ſhips, I would not abſolutely have any parrels nor running tackles at the lower yards: they

* In England the tacks only are ſingle, and the ſheets always double.

they are only ſo much more weight above, and ſo much uſeleſs rigging which ſhould abſolutely be ſuppreſſed, and ſupplied by 5, 6, 7, 8, 9, or 10 inch-ropes, according to the ſize of the ſhip. This is the manner in which I have ſeen it executed upon ſome large ſhips. You place on the yard a ſtrop on each ſide of the maſt, with a thimble, or bull's eye, wide enough that the rope may be introduced in it with ſufficient facility. When that is done, you introduce each end of your rope in one of the thimbles, ſo as to go out abaft the maſt and acroſs one of the other, in order to be brought afterwards on each ſide of the yard between the maſt and ſtrops; then you hook a ſmall tackle on the bight of the rope which deſcends along and a little abaft of the maſt. That tackle ſerves to tighten or eaſe the parrel,* according as you think fit, and as the weather requires. If it is very bad, you haul it very taught, and the yard then has no play. Let the ſhip pitch, roll, or toſs about as much as ſhe will, the yard is ſo well fixed that there is neither play nor ſhake from it on the maſt. Beſides the handineſs which reſults from ſo ſimple a machinery, it has again the advantage not to weigh the quarter of our ordinary parrels, nor to have the eighth part of their bulk. It requires no great difficulty to make it; for a piece of rope is all that is required for it; and if, by chance, a ſhot comes to ſtrike it, there is however no apprehenſion of being knocked on the head by a rib or a truck, as is the caſe with other ſorts of parrels.

The parrels of the top and top-gallant yards, ſuch as they are generally made, are not good for any thing. A common rope of 2, 3, 4, 5, or 6 inches, according to the ſize of the ſhips, with ſix or eight trucks upon it, is quite ſufficient; you have but to faſten it on each ſide to the yard, when on the cap, without making it too taught upon the maſt. Such a parrel will be infinitely more ſimple, leſs heavy, and more eaſy to handle, than the other kind.

It

* Parrels have not been in uſe for the lower yards in the Britiſh ſervice theſe thirty years.

It is again cuſtomary to fix at the head of the lower maſts two main gear-blocks, with two or three ſheaves each, for the uſe of hoiſting the lower yards, on which they ſtrop alſo two other blocks which correſpond with the two firſt. All this is abſolutely uſeleſs: it is only a very conſiderable weight on the head of the maſts, as well as a very great bulk, both of which muſt abſolutely be ſuppreſſed. It will be ſufficient to hoiſt the lower yards with two ſmall winding tackles, which ſhall be always kept in readineſs for uſe, in order to hoiſt them up, or haul them down, according as circumſtances require; and, when the yards ſhall be up and carried by their ſlings, then you take your winding tackles down. The two ſtrops over the yard, which you rack with the ſlings, being well placed in the middle of the yard, this will be much better balanced and labour much leſs when the tacks come to be hauled aboard. Now, no ſuch advantage can be obtained when there are any ſtrops over the yards; for, a certain diſtance is neceſſarily required between each of thoſe ſtrops; whence it reſults, that the yard can never be well balanced except when the wind is right aft.

After the lower yards ſhall be well balanced on their ſlings, you will belay their lifts and make them quite faſt for good. (We need not ſay that we ſuppoſe thoſe lifts to have previouſly been made ſo ſtrong as to be able, when the tacks are got on board, to ſtand the effort which requires the heaving taught of the weather bolt-ropes, before hauling the bowlines). I have ſeen a ſhip ſo well rigged, that I cannot forbear mentioning her here as an example of what I have always conſidered as being the beſt method of rigging.

Instead of fixing two ſtrops at the head of the top-maſt to reeve the top-ſails tyes through, you make the treſtle-trees of the top-gallant croſs-trees a little thicker, and ſufficiently large to admit of a ſmall block on each ſide, in which there is a ſheave to receive the tye. That block is to be ſerved with a deal cheek rounded by the top and gouged underneath, and ſufficiently large and eaſy, that the rope

rope which is ſtropped on the block ſhould not rub againſt the wood of the cheek as it ſlides up and down. That very wooden ſervice will be alſo as a ſupport to the rigging of the maſts heads, and prevent, at the ſame time, the water from getting to the ſaid ſmall block. By ſuch means two large blocks may very eaſily be ſuppreſſed, and nothing is ſeen at the head of the maſts.

THEN the tyes ſhould be fixed for good on the yard; and, in ſuch men of war as have but a ſmall crew, or in time of peace, you may place one block only on the yard in which the tye will be reeved, to make it run more eaſy.

IN the treſtle-trees, afore the firſt top-gallant croſs-tree, ſhould be introduced, on each ſide, a ſmall block with two ſheaves, on which ſhould be reeved the top-ſails, bunt-lines, and leech-lines; ſo that, by this operation, you would have eight blocks leſs on the collars of the Top Ma
Stays ~~top-ſtay's collars~~. Afore this laſt ſmall block, on the main-top-maſt treſtle-tree, you might place another with a ſingle ſheave, the uſe of which would be to receive the braces of the fore-top-gallant ſails, which thence would go back again to, and continue along, the top-maſt-ſtay as uſual. A~~back~~ baft the top-maſt croſs-tree which goes athwart the treſtle-trees, abaft the fore-top-maſt, muſt then be placed, on each ſide, over and upon thoſe treſtle-trees, a ſmall oblique block, with a ſingle ſheave, to receive the bowlines of the main top-gallant ſail.

THE top-gallant and top-gallant-royal tyes ſhould be reeved at the head of their reſpective maſts, in nicks cut in the knobs, and which would be contrived for that purpoſe; and, in order not to weaken the maſts too much, the main and fore-top-gallant lifts (whenever you mean to rigg any top-gallant-royal), might be reeved in ſmall blocks fixed at the head of the maſt for that purpoſe, without cutting any more nicks beſides thoſe which ſerve for the tyes.

IN order to reeve the ſtay-ſails, halliards, and ſtays, nicks with ſheaves muſt be contrived in the top-maſts caps: all kinds of mere

leading

leading blocks, hitherto uſed for the top-gallant clue-lines, lifts, and ſheets, ſhould then alſo be ſuppreſſed from the ſhrouds, and be ſupplied by thimbles or wooden travellers.

THEN the mizen top-ſail's braces ſhould be brought on the tenon of the main-maſt, its bow-line on the edge of the main-top, and the croſs-jack brace to the main catharpings: then the fore braces will come under the main-top and at the foot of the main-maſt, and the fore-preventer braces on the gang-ways.

WHEN maſting ſhall be made lower than it is now, it will be proper to ſet the main-top-maſt's ſtays ſo as not to incumber the fore-maſt; which object in order to obtain, they ſhould be made to go the one to the ſtarboard and the other to the larboard ſides of that maſt, in fixing their looſened dead-eyes preciſely even with the gammoning of the bowſprit, ſo that they will not fatigue any of the maſts, nor the fore-ſtays.

THUS have we fulfilled the main point of our object; and, as for the reſt, I believe I have ſaid enough to make any one conceive that he may eaſily find a full ſcope to exerciſe his imagination, in diminiſhing, wherever it will be practicable, both the bulk and the weight: which will certainly not be very difficult for ſuch as will but give themſelves up to that intereſting object, with ſome ſort of attention, and a ſincere deſire for the intrinſic benefit and advantage of the art of manœuvering.

I SHALL therefore not expatiate any longer on an article which is ſo arbitrary in itſelf, that, ſhould it be ever ſo well, it is almoſt impoſſible not to find means how to do ſtill better.

CHAPTER XI.

Thoughts on the method of forming ſeamen, and on regulating the ſeveral duties of the officers and crew at ſea.

IN all ſhips of war the ſervice is diſtributed; but, as the King's Statutes concerning the Marine do not preſcribe any thing particular concerning

concerning the diſtribution of that ſervice, the Captains diſpoſe of this matter as they think fit, which is generally according to the eſtabliſhed cuſtom. It might however be worthy of our conſideration, to try whether the common practice is not ſuſceptible of improvement.

I HAVE not the preſumption to imagine myſelf capable of giving deciſive principles on a ſubject, which would require in the writer more knowledge of the great art of governing mankind than I pretend to have. Therefore, I muſt ſolicit my Reader's indulgence for what I ſhall venture to advance in this Chapter, where I offer my reflections on a ſubject which may be looked upon as the firſt talent neceſſary to every man who is to command others.

THE ſcience of a Captain does not conſiſt, as many would inſinuate, in doing every thing himſelf. To flatter one's ſelf with being able to do ſo is a preſumption; to attempt to perſuade others that one is able to do it, is another no leſs ridiculous pride: beſides, the detail is the function and duty of the Officer next in command to the Captain who is only to direct thoſe who act under his immediate orders, and to exact an account from thoſe he has thought proper to employ, according to their capacity. If thoſe who affect to inſpect every thing with their own eyes, and viſit every quarter, were thoroughly convinced of this truth, that "a mind fitted to "deſcend to the minutiæ of buſineſs is only qualified for a ſubor-"dinate rank;" I make no doubt pride and ſelf-love would reſtrain them, and they would find their vanity more fully gratified by obſerving a different conduct; for, it is nothing but their vanity which prompts them to this frequent appearance, perſuaded that the oftener they are ſeen, the greater authority and reſpect they ſhall acquire from their inferiors; a moſt egregious error, which ſhews evidently they never had any idea of what a celebrated Author obſerves, "that the true genius in the art of commanding is he "who, without any mechanical operation of his hand, gets every "thing done; who reflects, diſpoſes, plans, directs, and is careful

" to leave nothing to the power of chance; whoſe principal attention " is to have a thorough knowledge of the talents of thoſe who act " under him, in order to employ them uſefully in the execution of " his deſigns."

THE conduct of a Captain, at ſea, ſhould be calculated to inſpire the ſhip's crew with a confidence in the officers placed over them. He himſelf ſhould therefore appear as ſeldom as poſſible, unleſs on general occaſions; for example: he ſhould always be preſent at all the exerciſes of naval evolutions; all the anchorings and getting under way; in chaſes and engagements; in a word, at all times when reſpect is to be inſpired, and the manœuvres require diſpatch. But in all other ordinary matters, ſuch as reefing, diminiſhing or increaſing the quantity of ſail to be carried, according to the weather; changing courſe, and winding about, &c, during the time of a paſſage; all this, I ſay, ſhould be executed by the Lieutenant, and the Captain ſhould have no farther concern in all this buſineſs, than ſo far as it relates to the orders he may have given him. By theſe means the crew not being accuſtomed to ſee him but on important occaſions, his appearance is then ſufficient to inforce reſpect, and to perſuade the men that the buſineſs required is eſſential; conſequently they exert themſelves with more ardour and confidence, eſpecially as they are farther excited by the Officers diſperſed in the different quarters of the ſhip, who, on thoſe occaſions, call forth their utmoſt vigour and activity.

SUCH regular conduct in the Captain inſpires the crew with confidence in their Officers, with whom they uſe themſelves, as they perceive they have been judged capable of the detail of buſineſs, ſince it has been left to them; a thing which is the moſt oſtenſible, it is true, but not, however, of great conſequence. This practice forms alſo the Officers themſelves; by exerciſing the crew, they acquire what is called the *coup-d'œil*, or quickneſs of diſcernment, which is of the greateſt importance in the preſence of an enemy: they

they learn to meaſure with more exactneſs the diſtances required between the different evolutions, and the time which each of them takes in its execution; and they become better acquainted with their own ſhip's motions. By theſe means, the number of Officers ſkilled in the art of manœuvering is conſiderably increaſed: but, on the other hand, unhappy is the Officer who happens to fall under an improper diſcipline; for, he then loſes much of his own knowledge, if he had any; and, ſhould he be totally ignorant at his firſt entrance upon duty under ſuch command, he will forever remain ſo, becauſe he finds no incentive to emulation.

The moſt frequent and moſt dangerous obſtacle to the improvement of the Navy is the command, which abſorbs and haraſſes the young Officers, inſtead of forming them. It renders the ſervice diſguſting, by making it as languid as troubleſome; languid, becauſe nothing is to be done without the Captain's orders, who, by ſhewing not a ſufficient degree of confidence in his own perſon, is ſure to fill thoſe under him with fear and irreſolution. So that, whilſt they are waiting for orders, they frequently remain inactive, which is very unpleaſant to a well-informed Officer who is qualified to diſcharge his duty.

I know not what could induce the greater part of our Sea-Commanders, to regulate the duties of the Officer under them in ſuch a manner as to leave him very little time for profeſſional ſtudy, when off duty. Would it not be the fear of ſeeing the common practice laid open, and the prejudice which ſupports it overcome by the knowledge of more rational principles? If that is the caſe, I muſt allow this fear is not ſo ill founded, in many reſpects: for, how much ignorance would then be expoſed! how many erroneous principles would be deſtroyed, through a practice enlightened by the ſimpleſt theory!

As I think differently from the Commanders, and other Officers who adhere to the mechanical routine, of whom there is a very con-

ſiderable number in the Navy, I venture to oppoſe this general obſtinacy; and I inſiſt that, in any ſhip where the formation of Officers for the ſervice of the State ſhall be at heart, every one of thoſe who compoſe the body of Officers of that ſhip, ſhould mount five guards at ſea, which are called watches, in order to qualify themſelves for the command, by being frequently expoſed to ſee and to practiſe what part of the ſervice they ſhall have theoretically before ſtudied and conſidered in the intervals from duty. From this diſtribution of the watches, there would reſult other advantages, which are, that the Officer having more reſt, would be more capable to ſet up and paſs the whole night on watch duty, when ſuch circumſtances require it, as bad weather, or the appearance of an enemy; on which occaſion the Officers of the watch might be doubled or kept upon duty: for, it is upon them that every thing depends on thoſe inſtants, when they are, more rigorouſly than ever, reſponſible to the Commander, for whatever may happen, by keeping an eye ſtill more vigilant over the ſentries, and on the execution of the manœuvres; whereas the labouring part of the crew, diſperſed about in the different quarters of the ſhip, may ſnatch ſome moments of repoſe one way or another upon the deck, and recruit their ſtrength, which is frequently exhauſted by labour and bad weather, to which they are more immediately expoſed than the Officer who commands them, and who is to direct the ſailors in the execution of the different manœuvres.

Not that I mean to exempt the Officer from all manual labour on thoſe melancholy occaſions, which but too frequently happen when he is under the neceſſity of acting the part both of a ſeaman and of an Officer. I am only ſpeaking here of the ſituation of a new fitted ſhip, ſailing on thoſe ordinary voyages, where ſickneſs, death, fight, and ſtormy weather, have not yet exerciſed all their deſtructive ravages. It is, therefore, in this ſituation of health and vigour, that activity is to be excited and cheriſhed, regularity and emulation promoted.

promoted. Eaſe and comfort even, I ſay, is to be procured to the Officer, and confidence inſpired to him, that, in caſe of neceſſity, he may be the more able to reſiſt any future fatigue; and he ſhould be exhorted, and even obliged, to apply himſelf to profeſſional ſtudy, ſhould he not be naturally ſo diſpoſed.

OFFICERS are all ſubordinate one to another on ſervice; ſo that there never is, nor can be, any equality among them. Thus the inferior muſt always obey the ſuperior, and the latter is anſwerable for the duty of the former. Nevertheleſs, with ſubmiſſion to better judgement, I imagine that the inferior Officer who commands the watch ſhould be conſidered, by the Officer above him, as a ſentry who cannot be releaſed from his poſt until his duty is over, or by a direct order from the Captain, from whom he derives the authority of his command, when at the head of his guard. So that the ſuperior Officer neither can, nor ought to command the manœuvre, or change the ſhip's courſe, without an order from the Captain; he cannot even move the leaſt thing without acquainting the Officer of the watch; and the reaſon of this is, becauſe the Captain is on board, and all authority, with reſpect to the ſervice, is derived from him: in his abſence the next in rank has the chief command, and ſo the reſt in order,

WHEN there are two Officers on the ſame watch, the youngeſt of the two ought always to be forward at the time of any evolution, and the other ought to be on the quarter deck.

ALTHOUGH the Captain be on deck, the Officer of the watch ought to be no leſs exact in the execution of his duty; but, then he ought not to order any thing to be done to the ſails without previouſly informing the Captain of his intention.

EVERY principal Officer has a right to go his round every where, at all times, and as often as he thinks proper.

IN the execution of any ordinary evolution no Warrant-Officer whatever ought to be allowed to put his hand to the manœuvre, in order

order to aſſiſt in any part of it (unleſs it be ſometimes to ſhew his people the way to execute it), becauſe he is there only to command and ſend every one to his poſt.

Every Warrant-Officer ought to obey, in every thing, the principal Officer, ſhould he even have a contrary order from another Officer, to whom then he is obliged to ſend word immediately of what happens.

The top-ſails muſt not, upon any account, be ſuffered to be hoiſted otherwiſe than hand-over-hand, without running and without jerk.

The whole body, both of ſailors and warrant, petty, and mechanical Officers together, is generally divided into two equal parts, in order to mount the guard or keep the watch alternately: theſe two diviſions are diſtinguiſhed by the names of ſtarboard and larboard watches.

Now, each watch ſhould be divided into three other parts. The firſt to be compoſed of the pilots, their mates, and the helmſmen, whoſe buſineſs is to keep an eye over the rudder, the way, and the courſe, under the Officer of the watch, to whom they are to give an exact account. In each ſquadron, they ſhall have for additional employment, that of keeping an eye to the ſignals, and to every thing which concerns the navigation.

The ſecond part to conſiſt of thoſe who work on the quarter-deck, about the manœuvres to be performed both aloft and below; and to be compoſed of all the mechanical Officers of the watch, and other petty Officers of the manœuvre, along with ſailors, and even ſoldiers when there are any, in order to execute whatever may be ordered by the Officer, either with reſpect to the working of the ſhip, the good of the ſervice, or mere cleanlineſs.

The third part to be compoſed of none but petty Officers of the manœuvre and ſailors only, without any mixture of other people, but ſuch in ſufficient quantity, however, as to be able to execute all the commands which ſhall come from abaft forward.

The

THE forces muſt be divided in ſuch a manner that there ſhould be no more a~~head~~ Forward than ~~aſtern~~ Aftard, and in number proportional to the manœuvres which are to be executed at either place, and *vice verſâ*.

A DISTRIBUTION is ſuch as it ought to be, when every thing is ſo diſpoſed that the command is executed with the utmoſt alacrity. And, in order to obtain more efficaciouſly that moſt favourable diſpoſition, I think the different ſets of petty Officers of the manœuvre ſhould be particularly ſpecified, who, with a certain determined number of men, alſo named and ſpecified, were on ſuch or ſuch an occaſion to get the command executed on ſuch or ſuch rigging; ſo that, by ſuch a precaution, no more and no leſs men would ever be employed than juſt requiſite for any evolution whatever. For example, in order to brail up a lower ſail, ſo many men, once for all named beforehand, would come immediately and range on the clue-garnets to leeward; ſo many on the leech-lines, and ſo many on the bunt-lines, with one or two petty Officers pre-appointed, and who would be experienced in what is to be commanded in ſuch a caſe: the ſame diſtribution and order would be obſerved likewiſe with reſpect to the weather-brails: whatever would be determined in that matter, concerning the lower ſail, would be underſtood to be the ſame concerning the top-ſail, with a certain fixed number of men for the weather-brace; and the top-ſail would be intruſted to a particular petty Officer of the manœuvre, appointed on purpoſe for the work aloft, the others being always underſtood to be aſſigned to inſpect and command nothing but the work below. When it will be to furl the ſails, ſo many men ſhall be aſſigned for the lower, and ſo many for the top ones, with each of them their particular Officers well known.

IF you want to put or tack the ſhip about, you muſt take care to diſtribute your people with method, in placing proper petty Officers every where; appointing ſo many men to the lower ſheets, ſo many to the tacks, ſo many to each brace, ſo many to the mizen and to the

the mizen top-ſail. Then, theſe men will be diſtributed afterwards about the braces and ſheets of the other ſails. Finally, whenever particular parts ſhall be allotted to any particular ſet of men, ſo as to make thereby their peculiar ſtation and employment diſtinct and conſtantly the ſame; and whenever ſuch particular allotments ſhall be rigouroufly kept up and obſerved, eſpecially in the beginning of each paſſage, you will always have the ſatisfaction to ſee afterwards every thing ranging as it were of itſelf to order, and the manœuvres will be executed not only with more method and exactneſs, but alſo with much more ſpirit: a point, all this, very eſſential to be obtained in the evolutions which are to be executed before an enemy, as well as in many difficult caſes, from which one could never be extricated without a ſingular celerity and alertneſs, which no one but a ſtudious mariner can ever be acquainted with; for, how many have been killed for want of executing their evolution with ſufficient alertneſs! How many, who have never been heard of ſince, have periſhed for want of vivacity and diſcipline!

ARTICLE I.

Of the clearing the ſhip for an engagement, or, Up all hammocks.

In this operation all the cloaths of the crew are to be diſtributed in the nettings, which are to be firmly ſeized to the iron cranes; and, when that is done, the whole is to be covered with a tarred four-threads cloth, ſo diſpoſed that, after having covered the whole with it, it may be faſtened underneath with bits of laſhings fixed in ſmall eye-let holes. Such a covering has the advantage of preſerving from rain and fire the beds and cloaths which belong to the ſailors, ſo that every thing may remain in that ſituation without inconveniency. For, in a battle, the bullets make no more than their hole, and nothing falls into the ſea: and if the wind blows ſome ſparkles

ſparkles by ſending ſome wads in fire, they fall back and do not ſet fire to the netting.

Just before coming out of the harbour, you will obſerve to rig, once for all,* the intervals between the ports, the tiers, and the fore-caſtle and quarter-deck, with foxes nailed on the edges, in order to deaden the ſplinters occaſioned by the bullets when they pierce the ſides of the ſhip.

In the cable ſtage, which is under the orlop, you muſt take care to keep ſpare top-maſts and ſails, ready prepared and fitted with their points, rope-bands, earings, &c, that you may have them ready at hand when wanted, either during or after the battle.

You muſt have a particular care alſo to keep the orlops very ſpruce, and cable tiers quite clear at the main hatch-way, that the Surgeons and wounded may have all the room neceſſary. It is a piece of humanity which does not allow any neglect on that head.

The wings are always, and at all times, to be kept empty and clear of every thing whatever, except the plugs or rollers of the calker, ready fitted and tallowed, to ſtop the holes made by the bullets at the water-line. You keep alſo, ready at hand, ſome leaden plates and nails, with ſtages prepared for ſuſpending the workmen without board, when the caſe requires. It is the buſineſs of the Officer who commands the lower tier to keep an eye over theſe things, and bring an account of their being all right to the Captain.

The Boatſwain's buſineſs is to ſee all the ſpare running-ropes (which muſt be kept by double and triple ſets) properly reeved. Theſe are the braces and preventer-braces, which are to be placed afore and aback of the yards in general, ſo that there ſhould be ſix braces to every yard: the ſtoppers, which are alſo to be placed on

* Not practiſed in the British Navy.

the clews of the top-ſails, on the tyes and falſe tyes, on the ſtanding parts of the braces, ſtays, and preventer-ſtays, with puddenings under every parrel, which are to be ſtrengthened in making them double: the guys of the lower yards are alſo to be made double; and the chains which are to go round the yard muſt be placed in ſuch a manner that they ſhould not obſtruct any thing.

Moreover, you muſt have ready on the quarter-deck, the fore-caſtle, and the tops, ſtoppers of all kinds and denominations, hatchets, tallow, marline, blocks, and ropes ready to reeve as, and in the ſtead of, what may be cut by the ſhot.

You muſt put a two-inch rope along the top-ſails bolt-ropes, which is to be fixed on little tablings placed on purpoſe to receive it; it will prevent the ſail from tearing athwart, in caſe the bolt-rope ſhould be cut.*

The boarding grapnels ſhould always be kept ready at each extremity of the yards, with their chains: many more of theſe muſt alſo be kept on the quarter-deck, fore-caſtle, and gang-ways, to throw with the hand and join better the two ſhips together. Theſe laſt grapnels ought to be very light, that they may be more eaſily handled. Some ſpare ones muſt alſo be preſerved, to ſupply thoſe of the yards, in caſe the firſt ſhould be cut down.

The ſails not in uſe are to be rope-yarned, that they may be the more readily unfurled when wanted.

When you ſhall be about fighting, in a line of battle, or in a body, you muſt take care to have ready on the quarter-deck, fore-caſtle, poop, and gang-way, ſome feruled fire-booms, light and handy, to repel the fire-ſhips: ſome others are to be placed alſo in the windows of the ward-room, and of the quarter-galleries. All theſe particulars are the concern of the petty Officer of the manœuvre

* Not done in the Britiſh Navy.

manœuvre, who is to go and give an account of it to the Captain before the engagement begins.

Too many precautions cannot be taken againſt fire. Therefore, you muſt have a particular care that there ſhould be nothing on the outſide of the ſhip ſuſceptible of catching fire; the ſame attention muſt be paid likewiſe to the nettings, which are to be covered as we ſaid before. Behind each gun are to be kept in readineſs two half tubs full of water, with their ſwabs.

There ſhould be kept in every ſhip two fire-engines, and always in good order. I cannot conceive how, in our Navy, ſuch a precaution could be neglected; for, it is of the utmoſt importance in many circumſtances, either to procure water for putting out the fire, or to wet the ſails in dry weather.

The Gunner's buſineſs is to prepare, and ſet in order, every thing which concerns the ſervice of the artillery. He muſt pay the greateſt attention to ſee that the cartridges ſhould not be wanting during the time of an engagement which may be laſting and warm. He is to cauſe to be diſtributed, in every poſt, iron cringles, to ſupply the deficiency of the rings and hooks which may chance to break. He is to deliver the grenades and grenade-tubs, in the tops, quarter-deck, fore-caſtle, poop, and gang-ways, with the matches for the grenadiers. The Gunner has alſo the charge* to ſend down in the ſtore-rooms, and in the cheſts, aback and afore under the Boatſwain's, thoſe who have the charge of diſtributing the powder under the orders of the Captain's Clerk: then he locks the hatch-ways and gives the key to the Officer who commands the deck, to diſpoſe of it according to the Captain's orders.

The Officers of each deck are to keep a cloſe eye to every thing; and, before the fight begins, to give an account to the Captain of

* Not in the Britiſh ſervice.

the good order which reigns every where through the ſhip. Then the Captain is to go his round himſelf in every place, when time will permit, before the engagement, and ſay ſomething agreeable to animate the crew and engage them to do their duty with ſpirit.

The Maſter-Pilot and his mates are to prepare every thing belonging to their department, *viz.* the ſignals; the truſſes, ropes, and tackles; the ſpare tillers; the helmſmen; the ſteering tackles in the gun-room; compaſſes, glaſſes, &c. He turns the three or four-hour glaſs at the moment the engagement begins; marks the courſe when the fight is in chaſing or retreating; ſets down the time of the various events, and the circumſtances of the engagement; he watches over the helmſmen and whatever is ordered at the binacle concerning the rudder, by the Captain and the Warrant-Officer of the manœuvre, on whom he is to have continually his eye fixed, that he may not loſe the leaſt ſyllable or ſign of the command.

Afore the binacle is to ſtand conſtantly an axiometer, vulgarly called the *tell-tale of the tiller*, which is to ſhew on what board is the helm, and by how much it is either way. It is again one of the charges of the Maſter Gunner to ſee that this inſtrument is in good order, and has nothing wanting.

In caſe of any ſounding, it is proper the buckets which hold the leads, lines, and plummets, ſhould be ready to leeward of the mizen-maſt, if the fight is on one board only.

The Maſter-Carpenter's buſineſs is to viſit all the galleries and wings, in order to keep them clear and ready, ſo that, in caſe of neceſſity, he may work in them with eaſe. He will keep all the hatchets in readineſs, and diſtributed in different parts of the ſhip, and hang ſome by their laſhes to the maſts. He muſt keep alſo in readineſs all his ſpare implements, that he may inſtantly replace whatever may happen to fail.

The Calker, after having well rigged, tried, and viſited all the pumps and their ſpare ſtores, ſhall place ropes outward and all around

around the ſhip above the water-line, ſtopped with iron ſtaples, to keep one ſuſpended to them by a gird, when required, particularly about the riſings of the ſhip's floor afore and abaft, where the blows are moſt dangerous. He ſhall keep in readineſs wooden plugs, wads of oakum, tallow and aſhes, leaden plates fitted and bored ready for nailing; all theſe things are to be dealt out in different places of the ſhip, in order to have them at hand, as well as the hand baſkets, knapſacks, and cork jackets, to fling one's ſelf overboard. He and his mates are to be perpetually on the watch and liſtening, to diſtinguiſh the ſhots which come to or under the water line, in order to remedy them inſtantly.

SCUTTLED caſks, filled with freſh water, ſhould be carefully placed on the decks and fore-caſtle, to refreſh the crew during the fight; and, in order that no body ſhould quit his poſt to go and drink, a tub ſhould be carried about by two men appointed on purpoſe for that particular buſineſs, and who muſt go from deck to deck and from poſt to poſt.

THE Maſter at Arms ſhall take care of the muſkets and piſtols, which he is to keep ready loaded and freſh primed, fit for firing. He ſhall inſpect and keep in readineſs the cutlaſſes, the battle-axes, pikes, halberds, and eſpecially every thing which concerns the ſmall arms. He ſhall deal them out about the different poſts, with the ammunition, ſuch as balls, grenade-matches, flints, and rammers: all theſe things are to be kept from accidents as much as poſſible. The ſame Maſter at Arms ſhall keep in readineſs alſo a certain quantity of ſpare cartridges, and full cartouch-caſes, fit to be delivered, in proportion as they ſhall be wanted, at the different quarters.

ARTICLE II.

Of what is to be obſerved during the engagement.

DURING the fight the greateſt ſilence is to be obſerved. No one ſhould quit his poſt upon pain of death. The wounded muſt be carried

carried or conducted to the Surgeon by thoſe who ſhall have been appointed by the Captain for that purpoſe. Should any one diſcover an advantage to be taken, he ſhall inform of it the Officer who ſtands neareſt to him. No kind of rigging whatever is to be touched without order. Should any dangerous ſhot be received at the water-line of the ſhip, ſuch of the calkers, or carpenters, or any other perſon as perceives it, ſhall inform, in private, the Captain with it, without ſaying a word of the ſame to any one elſe on pain of death, unleſs it be a ſuperior Officer: the ſame precautions ſhall alſo be obſerved about any part of the ſhip catching fire.

No gun is to be fired unleſs it be well loaded and levelled. It is better not to fire than to fire too raſhly and at hazard. A gun ought to be re-loaded as ſoon as fired, and none are to be left empty although one ſhould go from one ſide to the other ſide; in which caſe, three men are to be left to re-load it, and return afterwards to join their comrades. When there want people to execute the manœuvre, one may take ſome, with the Captain's orders, from the different guns, chuſing by preference thoſe who were aſſigned for boarding.

If, towards the middle of the fight, one ſhould think there are not a ſufficient quantity of cartridges and primes ready, people muſt be employed inſtantly in filling more of them in the magazines.

Should any one happen to refuſe obeying an Officer during the engagement, he ſhall be put to death on the ſpot; the ſame ſhall be done to any one who will hide himſelf or feign to be wounded.

Should one of the Enemy's ſhips, or a fire-ſhip, approach to board you, the greateſt ſilence is to be obſerved at that moment, in order to hear the commands of the manœuvre. You muſt ceaſe your firing on any other ſhip, to keep it for the veſſel who is coming up to you, and on whom you are to direct your whole broadſide loaded with bullet and caſe-ſhot. If your boats are out, as they ought to be when the weather permits, they ſhall take care to be in readineſs

readineſs to execute whatever ſhall be ordered them, in order to repel the fire-ſhips by throwing grapnels on board them to tow them off, and trying to take their guard-boats in order to prevent the retreating of their crew. Beſides, you are to try to ſink them with firing them under water, ſhould they even board you at laſt: and, if you ſee you cannot avoid catching fire, you muſt try to fling every thing you can overboard, that it may help to ſave ſomebody; then wet the powders, after having, through the main hatch-way, fired ſome ſhot from your lower deck in the hold of the fire-ſhips, to ſink them if poſſible.

WHETHER you board, or are boarded by another ſhip, you muſt take care to let fall the ports of the lower tier, to prevent any body getting in, and throwing grenades or ſetting fire to your ſhip that way: but the ports are not to be ſhut but when the guns can no longer be of uſe, by the two ſhips being ſo cloſe as to touch, as when you run along-ſide one of another.

WHETHER you are to windward or to leeward, ſailing large, ſhould you ſee the firing of your enemy decreaſing, you muſt ſeize the opportunity to board him fiercely, and take advantage of his confuſion, which can but be augmented by your attempt; then, throwing as many of your crew on board him as you can, you will undoubtedly complete his ruin.

ARTICLE III.

Of the order to be obſerved for an engagement; and of the exerciſe.

IN our ſhips, the crew, numerous as they are, are notwithſtanding weak, on account of the incapacity of the individuals: both ſailors and ſoldiers ſhould, therefore, be often exerciſed in the practice of the different manœuvres, the managing of the artillery and ſmall arms, and in the throwing of the grenades. The command of that exerciſe ought to be the ſhorteſt, cleareſt, and moſt conciſe poſſible.

Such

Such an application in training and bringing up beginners is, undoubtedly, the moſt important duty of a Commander: for, experience muſt have often ſhewn us that, between two men of war equal in crew and guns, the difference ariſing from more or leſs dexterity in the execution, and celerity in the manœuvering, as well as in the uſe of the artillery and muſketry, is ſuch that it is with very great difficulty it can be any wiſe balanced by any other circumſtance whatever. And, indeed, it is but by means of a very ſuperior fire, and as judiciouſly as ſkilfully ſerved, that we may overcome our enemy, eſpecially in the caſe of boarding, ſince it is impoſſible to force an admittance in his ſhip at any other moment but when the ſuperiority of our fire has compelled thoſe who defend her to yield.

We are not therefore to think ourſelves ſtrong becauſe we have a numerous crew, the moſt part of whom are but too often quite unexperienced: but we are to take pains in the forming and inſtructing of them, in diſpoſing them alſo in ſuch a manner that ſuch as know more ſhould teach thoſe who know leſs, and that no one ſhould be uſeleſs.

In order to come at that diſtribution of men in a crew, and to draw all the advantage poſſible from thoſe who compoſe it, this is what I think ſhould be done: every Captain of a ſhip, in time of war, ſhould, before ſtirring out of the harbour, be ready for fighting. Now, in order to enable himſelf to do it with more efficacy, he ſhould begin by making his quarter-bill, and divide all his people into four claſſes, that he may afterwards be a better judge how to make any alterations in it, and place every one in that particular ſtation where his private diſpoſition naturally calls him; which cannot be done without ſtudying and inceſſantly trying to penetrate and diſcover the true inclinations of every individual which compoſes his crew, in order, whenever the occaſion offers, to reap all the advantage poſſible of the whole.

The

THE *firſt* claſs ſhould be compoſed of the manœuverers.* Theſe men ought to be the moſt nimble and active, the moſt intrepid, the youngeſt, the moſt ſkilful in firing a muſket; and hence the fitteſt for boarding.

THE *ſecond* claſs ſhould be compoſed of mature men, capable of being at the head of a poſt, and to command guns. Theſe maſters of ordnance ought to have been long exerciſed in their buſineſs, and have often ſhot at a mark; and it would be right they ſhould all be at leaſt gunners-adjutant.

THE *third* claſs ſhould be compoſed of muſketeers, who are to know how to fire with dexterity, load quickly, and every thing elſe relative to the handling of fire-arms.

THE *fourth* claſs ſhould be deſtined to fill up the vacancies, when any happen, during an engagement, and to procure the people neceſſary in the hold and the wings. This claſs ſhould abſolutely be compoſed of none but mechanical Officers: and, in ſuch ſhips as will have a great number of people, thoſe who are ſupernumerary ſhould make part of this fourth claſs, when the other three have got their full complement.

WHEN a whole crew ſhall have been thus divided into four ſuch claſſes, and the men placed in each of thoſe which were thought moſt ſuitable to their diſpoſitions; it will be very eaſy to diſtribute them afterwards in the various ſtations which are to be furniſhed with people. In order to render this diſpoſition more ſtriking, we ſhall ſuppoſe here a 74 guns ſhip,

28 of which are 36 pounders,
30 - 18 pounders,
16 - 8 pounders,

with 800 men on board.

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* In the Engliſh ſervice, ſeamen.

THE *firſt claſs*, compoſed of manœuverers, muſt furniſh 166 men, who are to be diſtributed in the various ſtations where they are wanted, as follows:

	Men.
On the fore-caſtle, including the mechanical Officers,	60
On the quarter deck, including ditto -	40
On the poop, - - - -	10
On the main-top, - - - -	16
On the fore-top, - - - -	16
On the mizen-top, - - -	8
On the fore-braces, including the mechanical Officers,	16
TOTAL	166

THE *ſecond claſs* muſt furniſh,

	Men.
For 14 thirty-ſix pounders, -	210
For 15 eighteen pounders, -	165
To carry the cartridges (younkers)	29
For 8 eight pounders, -	56
Maſter Gunners, walking on the tiers,	2
TOTAL	462

THE *third claſs*, compoſed of muſketeers, ſhall furniſh,

	Men.
On the fore-caſtle, - - -	20
On the gang-way, - - -	20
On the poop, - - -	60
TOTAL	100

THE

THE *fourth claſs*, compoſed of thoſe who are to be diſtributed below, ſhall furniſh,

	Men.
For the direction of the powder (the Captain's Clerk),	1
To the ſtore rooms abaft and amid-ſhip, -	20
Ditto afore, called the Boatſwain's, - -	12
Carpenters and Calkers in the wings, - -	10
At the Surgeon's birth, including the Chaplain,	12
For the diſtribution of arms (the Armourers and the Maſter at Arms), - - -	3
Spare helmſmen, for the time of action, -	4
TOTAL	62

WHEN the crew is divided in the form above ſpecified, it will be proper to make it a point to place the Officers according to their merit, and to obſerve the ſame attention in reſpect to the ſoldiers and ſailors. For, in the diſtribution of the various employments, a Captain is not obliged to pay any regard to rank; a conſideration of this ſort in a ſhip would be attended with too bad conſequences. When preferments become the neceſſary conſequence of ſeniority alone, emulation withers, and the ſervice ſuffers, becauſe an Officer for being the ſenior is often not better. Therefore, the only rule to be adhered to in theſe caſes is always to appoint to the moſt difficult places ſuch as are moſt capable to hold them.

ACCORDINGLY there muſt be,

	Officers.
On the fore-caſtle, including the ſecond Captain,	3
On the quarter-deck, including the Captain,	4
On each tier, 5; for both, - -	10
At the flag on the poop, - -	1
TOTAL	18

So that, in order that ſuch a ſhip ſhould be well manned, ſhe muſt mount 808 men if ſhe is to fight in a line; though, if nothing but a cannonading was expected from her, 650 might do.

RECAPITULATION.

The commiſſioned Officers, -	*Officers,*	18
Manœuverers claſs, or ſailors, -	*Men,*	166
Gunners claſs, - - -	*Ditto,*	462
Muſketeers claſs, - -	*Ditto,*	100.
Fourth claſs, - - -	*Ditto,*	62

TOTAL AMOUNT OF THE CREW, 808 *Men.*

If it be poſſible to increaſe the number of principal Officers, it muſt not be neglected, in order to be able to multiply them at the ſeveral ſtations. That a Captain may reap a greater advantage from the Officers, he ought never to fail ſpecifying the number of guns he is to command on the tier where he is placed. The Officers commanding the different decks have no other fixed birth but the whole extent of the tier intruſted to their care.

Next to theſe diſpoſitions, which are known to every ſeaman, the companies for boarding are to be formed. Theſe are to be compoſed of 50 men each, and make ſo many ſuch companies as to take up three-fourths of the crew. At their heads are to be placed Officers of ardent and intrepid diſpoſitions: each of thoſe companies are to be diſtinguiſhed one from the other, in order to raiſe emulation in them, and they muſt be excited to do well: in order to obtain all which, the firſt company ſhall be compoſed of petty Officers, and of ſuch of the ſailors as are moſt vigourous and intrepid; the ſecond ſhall conſiſt of choice ſoldiers, all nimble, briſk, and bold: this company ſhall ſupport the firſt, and fight along with it. Theſe two companies ſhall be ſupported by all the others compoſed either of ſoldiers or ſailors, drawn proportionally from

from the different quarters, ſuch as the guns, the muſketry, or the manœuvre. All theſe companies in general ought to be armed with a piſtol, a cutlaſs, and a pole-ax. The two firſt, in leaping on board, ſhall be provided with two grenades per man; and, in that circumſtance, they ſhall receive matches ready lighted, which they ſhall wear in their hats, reeved in braſs pipes as are contrived for that purpoſe.

At all times the greateſt attention muſt be paid to maintain order and diſcipline, for it is of the utmoſt conſequence to be able to keep every man at the ſtation which ſhall have been aſſigned to him. If all the individuals know how to obſerve rigorouſly the diſcipline, there will never be found any difficulty in ſtrengthening the ſtations which ſhall have ſuffered any diminution, by drawing men from thoſe which have not ſuffered ſo much; ſo that, after an engagement, one may make as good a figure as if none had been loſt, although, in fact, more than a quarter of the crew may have been diſabled. All this may eaſily be executed when there are on board able and intelligent Officers, who take care to replace the men who are wanting by ſome others from the ſtations which can beſt ſpare them. By ſuch means, every Officer acting the ſame in the department which is intruſted to him, it reſults that one is always in the beſt order poſſible, and nearly equally ſtrong at every part.

Such diſpoſitions once ſet up, and the whole crew informed of them, they muſt be made familiar with them, by frequent and repeated exerciſes, till they are perfectly trained: and, when they are ſufficiently ſo, to know, and to handle their arms with dexterity; when they are capable of executing the command with celerity and preciſion, (either in reſpect to the manœuvre, which conſiſts in throwing well with the hand the boarding grapnels, and thoſe from the yards extremities; or in reſpect to the artillery, the firing of the muſketry, and the lancing of the grenades); they are made to execute ſeveral ſham engagements, various ſorts of boardings, ſup-

poſed,

poſed deſtructions of men at different ſtations, &c, in order to uſe them beforehand to the changes and variations which ſuch events may produce in a real engagement.

At the time of exerciſing the crew, you muſt not neglect ſpeaking to them often of boarding, in order to uſe them to view it without fear and in cool blood, to execute it with warmth and courage, and to conſider it as rather ſerviceable, and an incident of greater ſecurity to themſelves; for, prepoſſeſſion has a great influence over the greateſt part of men's actions. And, indeed, it is very true that this mode of fighting is not only more expeditious, but alſo, in general, leſs ſlaughterous than a cannonade, eſpecially for thoſe who board, and for the French Nation who have always found themſelves ſuperior in that kind of fighting.

The uſual method practiſed for exerciſing the crew in the art of fighting, is extremely defective,* by the quantity of uſeleſs time which is taken up in the exerciſe of the great guns, and by the omitted part of the exerciſe in the art of throwing the grenades. In the 6th and 7th Articles of the preſent Chapter, I ſhall preſent my

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* The very ſame obſervation is made by Falconer, in his Marine Dictionary, at the article Exercise, where he ſays, "The exerciſe of the great guns has, "till the late war, been very complicated, and abounding with ſuperfluities, in "our navy, *as well as all others*. The following method was then ſucceſsfully "introduced by an Officer of diſtinguiſhed abilities."

For the ſake of a readier compariſon with the method here propoſed by Mr. Bourde', we ſhall copy that mentioned by Falconer, which conſiſts of the fourteen following commands only:

1. Silence.
2. Caſt looſe your guns.
3. Level your guns.
4. Take out your tompions.
5. Run out your guns.
6. Prime.
7. Point your guns.
8. Fire.
9. Spunge your guns.
10. Load with cartridge.
11. Shot your guns.
12. Put in your tompions.
13. Houſe your guns.
14. Secure your guns.

my Readers with an example of thoſe exerciſes contracted with the greateſt preciſion poſſible.

Could the great guns be ſhortened without diminiſhing their range, there would reſult many great advantages for the Marine. Firſt, one might put under ſhelter at leaſt ~~ſome~~ from langrage and ſmall bullets the ſpare top-maſts and yards, which one is always forced to place on the gallows, fore-caſtle, and quarter-deck, becauſe otherwiſe they would obſtruct the recoil of the guns of the ſecond tier. In the ſituation they are now placed they are elevated above the gang-ways and expoſed to all the poſſible injuries from the fight. So that, after an engagement in which one ſhall have been diſmaſted or loſt ſome yards, one is very often unable to repair the accident. I was once witneſs of the two ſpare top-maſts being cut to pieces by the muſketry: ſuch an accident could not have happened, had one been able to keep them on the tier along the ſtrakes of the coamings of the hatch-ways. Beſides, in keeping, as we do, theſe ſpare yards and top-maſts on the gallows, we cauſe the ſhip's center of gravity to riſe, and we retard her velocity, ſince ſhe carries a leſs quantity of ſails, and ſhe is more diſpoſed to incline.

Should the great guns be ſhorter, one might introduce artillery of a certain ſize on the light frigates, which are generally provided but with very light ones, on account of the uſual weight and length of the great guns.

On the large ſhips which mount 36 and 18 pounders, 36 and 24 might be introduced, and even 48: becauſe this laſt would not have more weight than the preſent cuſtomary 36, on account of the ſhortening of the pieces, which I here propoſe partly from Mr. *Dulacq*'s opinion only.

If, content with the preſent uſual ſize of the pieces, one ſhould not care to put 48 for 36, nor 36 for 24, then there would be a very great difference in weight to be obtained from the propoſed ſhortening. And, the whole of the artillery of a man of war being lighter

lighter and ſhorter, the ſervice of the great guns would become infinitely more eaſy and quicker; ſo that, even upon a ſuppoſition of equality, in every other reſpect, between the two engaged ſhips, ſhe who ſhould be provided with the ſhorteſt guns would ſoon get the better of her enemy by the ſuperiority of her firing, whence would ſoon reſult that of the combat: a truth ſo much the more grounded as it is undeniable, a ſhort piece is a great deal better and ſooner levelled than a long one.

HAVING all thoſe advantages in view, I have conſidered that a ſhort piece, the charge of which would be incloſed in a chamber with the bottom made like an hemiſphere, on the largeſt circle of which the touch-hole would be bored, would reach farther than another piece longer of the ſame ſize, and the touch-hole of which would be even with the bottom of the chamber: becauſe the inflammation of the charge, in a ſhort piece, would be not only greater but quicker than in a piece of the ordinary ſize; as the firſt and ſecond inſtant of the inflammation carry the fire in all the points of the maſs of powder contained in the hemiſpheric chamber. Now, as it is proved by experience that the bulk of that inflamed globe is at leaſt four thouſand times bigger than before the inflammation; it follows that the axis of its flame is about ſixteen times as great as that of the globe of powder before it was inflamed; for 16 is the cubic root moſt approaching to 4000.

"So," ſays Mr. *Dulacq*, "that if, on a very ſmooth table, you "place, on one and the ſame line, three heaps of powder of an "equal diameter, and eight times that diameter diſtant from each "other, then ſet fire to the center of the middle heap, you will "ſee that it will communicate to the right and left heaps."

THERE reſults from that experiment, that if the extenſion of a globe of powder reaches on each ſide a diſtance eight times the diameter of its ſphere, when it is inflamed without being confined, that extenſion will be much more conſiderable when it ſhall be oppoſed

oppoſed by ſolid ſurfaces which will reſiſt its dilatation. For, the powder, which has been inflamed in the firſt and in the ſecond inſtant, finding itſelf confined and not able to dilate, it will be repelled from all the points of the concave ſuperficies which reſiſts it by the oppoſition it offers to the power of extenſion. And, as the inflamed fluid muſt needs extend, it will go, in a re-acting direction, through all the intervals which exiſt between the grains which compoſe the remainder of the charge, towards the leaſt reſiſtance, *viz.* the air which ſurrounds all thoſe divided particles. This firſt inflamed matter envelopes then, in the third inſtant of the inflammation, all the grains of powder which are contained in the ſpace of its extenſion, and conſequently beyond the whole quantity of powder incloſed in the chamber of the gun, ſuch as we propoſed and deſcribed it above. It is therefore evident, that if the fire inflames the powder as ſoon as it touches it, the whole charge muſt be inflamed at the ſame inſtant. " And," ſays again Mr. *Dulacq*, " if we conſider that " each grain of powder may be compared to a balloon, which a " ſudden wind inflates quickly, and in the ſpace of time which " is taken by the inflammation of a grain of powder, ſo that it " ſhould become equal to the bulk of a grain of powder inflamed " at liberty, it will appear evident that theſe balloons will tend, all " at the ſame time, to inflation; and as they cannot ſucceed on " account of the ſides of the chamber which oppoſe a ſuperior re- " ſiſtance, they will re-act, in dilating their ſpring towards the " weakeſt ſide; and all of them together, with a velocity increaſed " in ratio of their multiplied and momentaneous re-action, will " expel the bullet from the chaſe, along with the column of air " which oppoſes their iſſue."

But, as the reſiſtance of the metal of the breech has compelled the totality of the powder to inflame and to re-act towards the chaſe, there reſults from it the recoil of the gun, which will be ſo much the more violent, as the powder which took fire in the firſt moment

of the inflammation has communicated it to the inferior part of the firſt ſphere, and to another portion of the remaining part of the charge compriſed within the ſpace of its extenſion: ſo that, in the ſecond inſtant, the fluid is expelled with violence, ſince the greateſt part of the charge is inflamed, and the effort of the inflammation, which is nothing but an hemiſphere, could not be ſufficient to put in motion the remaining portion of the powder, the bullet, and the tompion which faſtens it.

From that delay, there reſults a greater inflammation; and it would be eaſy to demonſtrate, that the little quantity of powder which remains in its natural ſtate, gets inflamed in the chaſe by a third inſtant of operation, at the moment when the ſhot begins to ſtir: whence it follows, that the range of the gun muſt be increaſed, and the ſhot carried a great deal farther than it would, by a piece in which the inflammations would not be ſo ſtrong nor ſo quick, on account of the cylindric form which is generally given to the chamber, and the touch-hole of which is bored at the back, or farthermoſt extremity of that chamber.

From all this reaſoning are to be deduced the motives which are to determine to bore the chamber of the gun hemiſphere-like, by preference to the cylindric form, and to place the touch-hole on the great circle.

Repeated experiments having proved, in the ordinary pieces, that, to obtain their longer range, the charge of the powder muſt be proportioned, in reſpect to its weight, to the third part of that of the ſhot to be expelled by it, we ſhall adhere to that quantity of powder; as our object is not here to increaſe the range of the gun, but to preſerve only the ſame range undiminiſhed, although the piece itſelf be much ſhortened, in order to make it lighter.

Should the touch-hole be bored in ſuch a manner as to ſet the fire on the center of the axis of the charge, it is clear the inflammation of the powder with which it is compoſed, and the expulſion of the

the ſhot, would both receive an increaſe of velocity; becauſe the extenſion of the powder meeting with a greater compreſſion and precipitation at the ſame time, the inflamed balloons would ſpring looſe more in number at once in the ſame ſpace of time, and would conſequently produce a greater rapidity in that kind of action; whence their impulſion on the ſhot would be ſtronger, not only on account of the greater number of the particles of powder which would act together and at the ſame inſtant, but again on account of the multiplied elaſticity and velocity of the re-action. This reaſoning proves to a demonſtration, that a recoil much greater and much more violent muſt be the reſult of this operation, ſince there is a greater quantity of powers acting together on the concave parts of the chamber. Hence, it is eaſy to conceive that the carriage of the gun muſt be much agitated, and expoſed at laſt to be broken to pieces, by ſuch repeated efforts of the piece during an engagement. It would be then neceſſary to loſe ſomething on the range, in order to avoid an accident of that dangerous conſequence in a ſhip, where all thoſe reſources and conveniencies cannot be had which might be procured on land. Let us therefore conclude, that the touch-hole cannot be bored at a better place than on the large circle of the hemiſpheric interior cavity of the breech; becauſe, if it were placed on the center of gravity of the charge, it has been juſt demonſtrated that the recoil would be too violent.

If the communication of the touch-hole were placed directly over the farthermoſt part of the cavity, the recoil, it is true, would be much leſs, but there would be too much loſs on the range; becauſe the grains of powder at the bottom being the firſt inflamed, the greater oppoſition they meet with from the breech, obliges them to re-act towards the ſlighteſt reſiſtance: accordingly they drive before them, in proportion as they catch fire, the remaining part of the charge, in inflaming only but a portion of it, the effort of which, being ſuperior to the reſiſtance of the ſhot and the tompion, expels

both from the chaſe before the whole is totally inflamed. This will appear evident, if we conſider that, when the fire communicates to the charge by the breech-ſide, it inflames the remaining part but by that one end only; when, on the contrary, if it communicate nearer the center of gravity, it inflames both ends at once: therefore it has been preferred to loſe on the range, rather than to be expoſed to an accident.

We hope we have ſufficiently demonſtrated, that the hemiſpheric form of the chamber of the propoſed great gun, may produce the effect we wiſh for, *viz.* a more copious and a quicker inflammation. Now we are going to enter upon the range of the piece, to which we allow but 12 calibers in the length of the chaſe to contain the powder, the ſhot, the langrage, and the wads which are put over the charge; becauſe we have demonſtrated, that the powder which fills up the chamber is almoſt all inflamed when the ſhot begins to ſtir, and is quite ſo when it comes out of the chaſe. It is then evident that, if the piece were longer, the moving power ceaſing to act as ſoon as the powder is conſumed, the friction and jolting of the ſhot againſt the exceeding part of the length of the gun, would diminiſh the range. Beſides, the remaining part of the powder which follows the ſhot, completing its inflammation, when the flame of that which began to kindle is, after a ſufficient dilatation, juſt extinguiſhed; and after the air, at firſt rarefied, is deadened on that ſide (ſince the ſhot, by yielding to its effort, has left it all the neceſſary room for extenſion), the ſhot can no longer receive any impulſion but from the remaining part of the powder by which it is followed immediately; but this portion of powder expels it only with a very faint force, ſince it has the opportunity of re-acting towards the vacuum which exiſts now between the ſhot and the breech, in ſuch a manner that, were the piece to be longer, all moving power ceaſing to act, the velocity which the moveable body would have acquired by the impulſion of the powder in its various ſtages of inflammation, would

would be employed partly in driving off the column of air which would reſiſt it ſtill in the remaining part of the piece's chaſe, which would be again an additional and conſiderable cauſe of the diminution in the range. Therefore, there is an abſolute neceſſity of ſhortening the gun, and to allow it but juſt the length which is neceſſary for the powder of its common charge to complete its inflammation preciſely at the moment the ſhot quits the mouth of the gun.

THEY uſe, in the navy, all ſorts of pieces of artillery, from 4 to 48 pounders incluſively. Thoſe great guns are diſtributed on the ſhips conformably to their ſize and ſtrength. They are ſet on four-wheel carriages, the ſhape of which need no detail, as it is ſufficiently known to ſea-faring men. The beſt carriages are thoſe which are ſloped underneath, becauſe they are the lighter.

THE Engliſh have invented a kind of carriage more advantageous than any other, in ſo much as the upper part turns along with the two cheeks on a pivot, and as a ſingle man may alone level a gun from right to left. Although a carriage of ſuch a conſtruction be much heavier than the others, it would not however be very difficult, in adopting the contrivance, to give it more lightneſs.

ARTICLE IV.

Of the exerciſe of the great guns.

THE Cannoneers having repaired to their quarters in a ſufficient number to manage well each gun, they are to be made to obey the command in giving a ſilent attention to it.

1ſt COMMAND.——*Caſt looſe aprons and tackles.*

EXECUTION.—THIS command is executed by the Captain of the gun, who looſens the apron, and by two other men, who alſo caſt looſe, both together, the laſhing tackles on each ſide of the piece,

piece, laying their falls on the deck, ready to be overhauled by the recoil of the gun after firing.

2d COMMAND.——*Uncover the vent.*

EXECUTION.—THE Captain of the gun takes off the leaden apron which is on the vent, and places it more forward on the gun, ſo that it may not obſtruct the priming.

3d COMMAND.——*Prick the cartridge.*

EXECUTION.—THE Captain of the gun takes the wire with his right hand, and introduces it into the vent of the gun, forcing it on the cartridge, and makes it go up and down two or three times, in order to be certain that it is broken.

4th COMMAND.——*Prime.*

EXECUTION.—THE Captain of the gun takes the powder-horn with his left hand, after having opened it, and pours ſome powder on the vent, in which he makes it go down with the priming-wire; obſerving, at the ſame time, not to cram it too hard. When the vent is full, the ſcore which leads to the pan is to be filled alſo with powder; or, when there is no pan, a train of gun-powder is to be made from the vent to the baſe-ring and ogee; then this part of the priming is to be bruiſed with the horn.

5th COMMAND.——*Point your guns.*

EXECUTION.—THE Captain of the gun, and all thoſe who are to handle the crows and hand-ſpikes, take each their ſtation: then the former takes off the apron from the gun, that it may not obſtruct the pointing.

6th COMMAND.——*Cannoneers! point forwards.*

EXECUTION.—THE Captain of the gun orders the breech of the gun to be heaved down aft; or, he turns it ſo himſelf, if the gun is mounted on a carriage with a pivot.

*6th COMMAND.——*Point aft.*

EXECUTION.—THE Captain of the gun orders the breech to be heaved forwards, till the muzzle comes in a line with the object on which it is to fire.

**6th

**6th COMMAND.——*Point a-beam.*

N. B. *This is the beſt method of firing at ſea; becauſe the object is always taken by its middle, eſpecially if you uſe your cannoneers to take always the mid-ſhip for their mark.*

EXECUTION.—THIS command is to inform the Captain of the gun, that he is to fire abreaſt his ſhip: he executes it by placing his gun ſtraight in the middle of the port, and pointing to the upper works of the adverſary.

**6th COMMAND.——*Point for ſinking.*

EXECUTION.—THE Captain of the gun raiſes the breech ſo as to be able to fire the ſhot below the water line of the ſhip on which he fires. When that way of firing is executed, it is proper to be very cloſe to the enemy, in order not to loſe the ſhot.

7th COMMAND.——*Fire.*

EXECUTION.—HE who is to execute this command, ſteps to the left ſide of the gun, holding with his right hand the match; and, as ſoon as the Captain of the gun has finiſhed pointing it, he ſets fire to it himſelf, if the gun has a lock, or he gets it done quickly by him who has that office.

8th COMMAND.—*Fix the crow before the trucks, and faſten the train-tackles.*

EXECUTION.—ONE of the men places the crow under the fore truck of the carriage after the gun has ſufficiently recoiled, while others haul taught the train-tackle, and ſeize it in making with the falls an half-hitch over the inner block.

9th COMMAND.——*Traverſe the gun.*

EXECUTION.—THIS movement is done to procure eaſe to the man who loads the gun; and is executed in placing the muzzle of the gun almoſt on one ſide of the port: this command may be very eaſily executed with the new kind of carriage we have mentioned before; for, then the gun might be loaded abſolutely on the inſide of the ſhip, and under the cover of the ſhip's ſide.

10th COMMAND.——*Ram down the ſpunge.*

EXECUTION.—THE loader takes the ſpunge and rams it down to the bottom of the chamber, while the Captain of the gun holds his thumb on the vent, in order to extinguiſh the fire which might have remained at the bottom of the cartridge in the bore of the gun.

11th COMMAND.——*Draw back the ſpunge.*

EXECUTION.—THE loader turns round quickly the ſpunge in the chamber of the gun, and then draws it back, continuing to turn it.

12th COMMAND.——*Put in the cartridge and wad.*

EXECUTION.—ONE of the men, who has the charge of keeping the cartridge boxes, introduces the cartridge into the gun, and the loader places over it a wad; it is to be obſerved, that when the cartridge is taken out of the box, it muſt be done very near the mouth of the gun.

13th COMMAND.——*Ram down the charge.*

EXECUTION.—THE loader, who, during the execution of the laſt command, has quitted* the ſpunge to take the rammer, puſhes down with it the charge into the chamber of the gun, and ſtrikes it ſtrong enough to make himſelf ſure that it is home, which is proved by the priming-wire which the Captain of the gun introduces through the vent, in order to feel the cartridge; and when he is ſure of it, the rammer is drawn out.

14th

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* In the Britiſh Navy, the ſpunge and the rammer are but one and the ſame rod, at one of the ends of which the ſpunge is fixed, while the other ſerves to ram down the charge: ſo that, without any loſs of time, the loader, after having ſpunged the gun, only turns the rod, and is ready prepared to ram down the cartridge with the other end, which he executes with the greateſt celerity, as ſoon as the man has placed it, with the wad fixed to it, at the entrance of the gun's muzzle.——TRANSLATOR.

14th COMMAND.——*Shot and wad your gun.*

EXECUTION.—ONE of the men introduces the ſhot a little way into the gun, and the loader places the wad over it which he has received from another; then he rams it down home to the powder with a ſtroke, and draws back the rammer.

15th COMMAND.—*Range yourſelf to the tackles, to run out the guns.*

EXECUTION.—THE Captain of the gun ranges his men equally on each ſide of the piece, along the tackle-falls, which are to haul and ſecure the gun to its port; and, immediately after, he puts the breech on the axle-tree, that it may not be cumberſome.

16th COMMAND.——*Run out your guns.*

EXECUTION.—THE crow is to be taken out from afore the trucks, and every man hauls while another eaſes the half-hitch of the train-tackle; and the Captain of the gun directs, from aback, his gun ſtraight through the middle of the port.

17th COMMAND.—*Cover the vent, and make faſt apron and tackles.*

EXECUTION.—THE Captain of the gun covers the vent with the apron; then, two men make each a turn and a hitch round the pomiglion with each of the tackle-falls, and reeve the bight between the gun and the taught tackle; after which the Captain of the gun faſtens the apron on the tackle-falls which are on each ſide of the gun, in making a knot over the middle of the apron.

ARTICLE V.

Obſervations on the exerciſe of the great guns.

WHEN the guns have got muſket locks, you muſt abſolutely take care, after every firing, to wipe the upper and under part both of the flint and of the pan.

IT would be better to make uſe of tubes in lieu of common priming: the firing would be much quicker, becauſe one would

always take care to pierce* the cartridge before truſting the tube into the vent; and, in that caſe, a train only of gunpowder might be made from the vent to the pan.

My opinion is, one ſhould never make uſe of bar-ſhot, flail, nor of any other thing of this kind; becauſe a bar-ſhot never does much injury in the upper works. I had rather make uſe of a round ſhot, becauſe wherever it ſtrikes it gets in much more eaſily than any other, and weakens therefore, ſo much the more, the ſtrength of the wood; beſides, the ſplinters occaſioned by it deſtroy often a great many people.

I should wiſh likewiſe no other langrage was made uſe of but grape-ſhot, formed with ſmall bullets, of two, one, or half a pound weight, according to the caliber of the guns. This may be fired at a quarter or a third part of a common range. When the two ſhips are near, and within piſtol ſhot, I ſhould have the guns charged with ſmall bags of canvas filled with leaden two-ounce balls, and always, beſides, a ſhot of the caliber of the piece.

When muſket-locks are fixed to guns, they are ſet in a wooden ſtock, in the ſame manner as they would for a muſket. To that ſtock they are made faſt with two good ſcrews, the heads of which are either on the outſide or inſide of the ſtock, but ſo well let in, however, as not to exceed the ſuperficies of the wood, becauſe they would prevent this ſtock from joining quite cloſe to the gun, which muſt be very carefully guarded againſt; for, ſhould there fall any powder between the ſtock and the gun, when it is priming, there would be a danger of blowing up that machinery. From the pan of the lock to a quarter of an inch of the vent, there muſt be a braſs channel, to convey the fire to the charge by means of a train of powder

* The tubes uſed in the Britiſh Navy are ſo contrived as to be ſufficiently peaked at their end, for pricking the cartridge at the ſame inſtant as they are truſted into the vent.——Translator.

powder which will fill it. That channel muſt be bent in the inſide of the ſtock on which it will be mounted, ſo that the pan ſhould join it exactly, without there being any poſſibility for a grain of powder to drop between them.

THERE is to be a mortice in the ſtock through which is to paſs the trigger, which is to be fixed in that mortice, at the collar of the two perpendicular branches which compoſe it, by a little round pin, on which it will turn, to make the cock go when you want to fire.

A LINE ſhould be faſtened to the vertical branch of the trigger, that the pointer may the more eaſily fire from aback the piece, without ſtirring, or having any thing to fear from the recoil.

THE objections which might be made againſt the uſe of locks applied to the great guns, fall of themſelves to the ground, by the experiments we have ſeen in trying them. They are mounted, as we ſaid before, on a concave piece of wood fitted to the piece, and long enough for one of its extremities to be even with the after-part of the breech of the gun, and made ſecure to the pamiglion with a laſhing, and the other extremity faſtened round the cylinder of your metal, at about eight inches forward from the vent, with laſhings of the ſame ſize as that abaft.

THE depth of the ſtock muſt be ſuch that the fire-lock may be incruſtated in it eaſily; and its thickneſs ought to be of three inches or thereabouts.

ARTICLE VI.

Exerciſe for throwing grenades.

1ſt COMMAND.—*Take up the grenade.*

EXECUTION.—THIS command is executed by taking the grenade with the right hand, ſo that the fuſe ſhould be upwards between the thumb and the fore finger.

2d COMMAND.—*Uncap the fuſe.*

EXECUTION.—AT this command the paper which covers the fuſe is torn off with the left hand.

3d COMMAND.—*Take the match.*

EXECUTION.—THIS movement is again executed with the left hand, by taking the match, which ought to be lighted in a braſs pipe, and fixed to the hat with the lighted end behind. It muſt be put out immediately after uſing.

4th COMMAND.—*Fire the fuſe.*

EXECUTION.—THE fire is put to the prime with the match; and, as ſoon as it is well lighted, the grenade is to be thrown with all the ſtrength of the arm, in ſuch a direction as to fall where intended. The fuſe muſt be neither too long nor too ſhort.

THIS exerciſe is neither long nor difficult; nor indeed is any thing which may ſerve for the inſtruction of the crew. Such exerciſes are therefore not to be neglected; and to be well executed, they require but a common ſhare of underſtanding. But, thoſe who execute the command beſt, and who ſhew the greateſt diſpoſition to do well, are to be noticed and rewarded, which will inſpire the one with emulation, and the other with jealouſy. In order to uſe more eaſily, thoſe who are intended for throwing grenades, to this exerciſe, they ſhould in the beginning be made to throw ſome not loaded, and only with primed fuſes: and, when they are found to ſucceed according to wiſh, they ſhould have ſome papier-maſhee grenades charged, which they are to practice throwing as they did the former. If they throw theſe with dexterity and boldneſs, they may then be tried to throw ſome iron ones in the ſame manner, and to make ſome burſt: if that trial ſucceeds likewiſe as well as in the precedent exerciſes, there is ſome likelihood of having got good grenadiers.

As this kind of fire is of material conſequence in boarding, where it cannot be too much multiplied, it is abſolutely neceſſary that the whole crew ſhould be uſed to the exerciſe of throwing grenades.

IF

If, in all the exerciſes of the manœuvre of the canon, and of the handling of the other fire-arms, a Captain ſhews reſolution, ability, equity in rewarding merit and puniſhing indolence, it is likely he will not be long before he acquires the confidence of his crew: and hardly ſo much as that is wanting to make bright ſtrokes. This ſhould be a very powerful reaſon to excite, in that reſpect, the emulation of the principal Commanders, could they be well perſuaded of it.

The ſecurity and the negligence of the Captains is the true cauſe why our crews are not ſo good as they might be made: for, they fail not on the ſide of courage; the *Barth*, the *Duguay-Trouin*, and many more, have proved it enough to all Europe; and it has been proved alſo in all the circumſtances, where they have been commanded by men who knew how to excite their emulation.

We think it our duty to repeat here an obſervation of Marſhal *Saxe*, who knew ſo well how to conduct men. "A continual "exerciſe makes good ſoldiers" (and good ſailors), "becauſe it "fills them with ideas relative to their ſituation, and teaches them "to deſpiſe danger, as it makes them familiar with trouble and "labour. The tranſition from fatigue to reſt enervates them: it "offers comparative points which it is difficult to join, without "occaſioning that ſo common and ſo powerful paſſion incumbent on "man, idleneſs, to grow, without inciting murmur, and weaken-"ing the ſoul after having weakened the body."

To this reflection I ſhall add another. During the peace the Royal Navy remain inactive; while the mercantile marine trades quietly without any warlike idea. So that, after a peace of ſome duration, the State poſſeſſes, it is true, good ſailors, but ſuch ſailors as have not the leaſt idea of what is to be done in a ſhip of war; they know not even the arms which are uſed in ſuch a circumſtance. Now, ſince merchant-ſhips are thoſe which form the ſailors, they

ſhould

ſhould then exerciſe them in the handling of arms alſo : and every ſhip which goes to ſea, ſhould make it a point of cuſtom to practice twice a week *up all hammocks*, and the exerciſe, be the weather whatever it would. This would coſt nothing, and would compleat the training of the crews, by offering them inceſſantly an idea of war, which is analogous enough with the rough diſpoſitions of a ſea-faring man.

ARTICLE VII.

Obſervations on the attack.

Before attacking, every Frenchman ought to be perſuaded that it is neceſſary for him to combat very cloſe, becauſe the vivacity of the Nation makes her always ſuperior in muſketry, and, beſides, one is more able to take the advantage of boarding when the opportunity offers ; an occaſion which never ought to be neglected, but, on the contrary, ſought for, becauſe the ardour of fighting and the *coup-de-main* are the peculiar characteriſtics of the Frenchman. Whenever, therefore, an occaſion for fighting ſhall offer, it will be neceſſary to make every thing ready for boarding ; and the way of doing it with ſucceſs is to ſpeak conſtantly of it to the crew, and to excite them to it by the hope and attraction of plunder, which muſt be allowed to a certain degree, though with moderation, whenever you happen to take poſſeſſion of a ſhip by that always deciſive and never failing method.

Another conſideration is, that it is always advantageous to be the aſſailant, becauſe it makes the adverſary ſuppoſe you have nothing to fear ; therefore it fills him with terror and your crew with confidence, both at the ſame time. For, generally, when you attack, it is conformably to a plan you have formed to yourſelf, and which your adverſary can ſeldom gueſs at but in the courſe

of.

of the engagement; and then it may be too late to try to break measures which have been thus premeditated.

When a Commander is going to attack a ship, he must not be wholly taken up with his project of attack or manœuvre: he must also think of and guard himself against all the surprises of manœuvre which his enemy might attempt, and judge, by the position where his adversary is, of all those he might try in order to draw him into some snare, or to avoid those he might lay out for him, and not to lose at the same time his principal object in view; for it is a point which he must not lose sight of, whatever may be the situation he is in.

I should not be of opinion to receive the first fire of an enemy, unless it be at a distance: for, when close to each other, the first broadside is always the most dreadful. It may strip you of very essential rigging, kill a great many of your crew, and expose you thereby to surrender for mere want of being able to manœuver. The greatest advantage is then most certainly for him who fires first when close to each other; for, if you are but tolerable marksmen, you disable partly your adversary, you kill many of his people, very often you stun him, and the broadside which he returns is seldom well pointed.

If the ship you are attacking pops and pops again at a distance, let him do so without return; for he will never cause you much damage that way: but, you must manœuver so as to approach him as fast as you possibly can, that you may stun him by a fire well served, and salute fashion, that is to say with shot fired quickly one after another and well pointed.

When you come to boarding, no one is to be suffered to leap on board before the fire of the musketry and grenades has made the enemy abandon the fore-castle, quarter-deck, and poop: and when you see your adversary begin to yield or be frighted, you redouble your efforts, and then let go boldly on board those who were destined for

for boarding, provided however you ſee they may paſs in a ſufficient number together to ſtand on and make a good reſiſtance to the repulſe they muſt expect to meet with.

When you fight in line, or ſingly, you muſt be well perſuaded that the moſt dangerous thing is to yield, ſhould it be ever ſo little; becauſe, on the one hand, this motion emboldens your adverſary, who, in ſuch a caſe, redoubles generally the vivacity of his fire; while on the other, your crew ſlacken, and loſe their ſpirit and confidence; your fire diminiſhes, and your people always imagine that your caſe is of a more dangerous conſequence than often it is; for, the leaſt act of timidity or intrepidity in a Captain influences powerfully the diſpoſitions of his crew, either for the worſt or for the beſt.

This is the place for propoſing an idea, the putting of which into execution ſeems to me of very great importance, could it be admitted. Every one allows that a Captain is the ſoul of his ſhip: the whole crew fix their eyes upon him and examine him in all the perilous circumſtances. He alone is the true mover of the actions of each individual, eſpecially in an engagement, when every thing good or bad is charged to his account. It would therefore, methinks, be very eſſential that ſuch a principal man at leaſt ſhould be a little more ſheltered againſt the blows than any other Officer or ſoldier who has nothing but his own perſon to anſwer for, and whoſe loſs is not of ſo dangerous tendency for the remainder of the crew. I could then wiſh that the Captains of ſhips ſhould, during an engagement, be covered with a good armour muſket-proof, which would be a great advantage, for they would then have hardly any thing elſe to fear but the great ſhot. This armour could not be cumberſome to them, becauſe they are not expoſed to leap on board the adverſary as thoſe of the crew who are under their command; they are bound never to quit the deck on which they are acting, and they are not to go from one place to the other: thus, an armour

could

could not hinder a Captain from executing with eaſe all the motions neceſſary in the courſe of an engagement. The utility and advantages reſulting from ſuch a precaution can therefore not be denied; for, how frequently have ſhips been taken, who never would, had not the Captains been killed, and had not their death filled the crew with diſmay and confuſion! And, indeed, it muſt be allowed that, in ſuch a circumſtance, a general diſcouragement ſeizes on the minds of all the crew, who no longer make any but falſe manœuvres; the fire is badly ſerved, and the end is always a ſurrender. After all, it is leſs for one's ſelf than for others and the State, that a Captain is bound to take care of himſelf: therefore, he ſhould not be aſhamed of wearing armour; for he muſt before have given ſufficient proofs, when he was a ſubordinate Officer, that fear is not the motive which induces him now to think of his preſervation. Prejudice ſhould not then prevail here againſt reaſon ſupported by the motive of public good.

CHAPTER XII.

How to brail up a top-ſail and a lower-ſail in ſtreſs of weather; with the method of ſetting them.

IN order to clew up a top-ſail in ſtreſs of weather, with the wind either large or cloſe hauled, without running the riſk of ſplitting it, you muſt lay hold of the weather brace and faſten it very taught, without looſening the bow-line, which is to be made faſt as ſoon as the top-ſail is on the cap; next to this, you range your people on the two bunt-lines, the leech-line, and the weather clue-line, which is to be made faſt, in looſening on the weather ſide: then, all the ſailors acting with ſtrength on all the brails, you eaſe off the bow-line, and when the clue-line is up on the weather ſide, you call the ſailors who were on that ſide, as well as thoſe of the leech-lines,

to the leeward ſide; and when they are ranged on the leeward brails, you looſen the ſheet on that ſide, and haul all up as quick as poſſible, that you may after that be able to brace the top-ſail taperly, that is to ſay, on the parallel to the direction of the wind, in order to furl it more eaſily. This mode of clewing up is certainly the beſt, the quickeſt, and the ſafeſt, whatever may be ſaid to the contrary by thoſe who know no other rule but cuſtom, and who are not therefore ſenſible of the phyſical cauſe of this operation, which we hope we have ſufficiently made evident and clear, when we ſpoke of the natural tendency the ſails have to range themſelves perpendicularly to the direction of the fluid.

When, in ſtreſs of weather, you find yourſelf obliged to ſet a top-ſail, you muſt firſt begin to haul home the lee ſheet, after having braced the yard ſo as the ſail may take the wind in; and, when that ſheet is home, you will paſs to the weather ſide, where you will do the ſame. This method is grounded on the ſame principle as the preceding one in brailing it up.

When you wiſh to brail up a lower-ſail, the lee-clue garnet, as well as the leech-line and bunt-line, are to be brailed up firſt; and when that clue ſhall be up, you will paſs to that of the weather ſide, and haul up the weather-clue of the main-ſail: a little while after you will eaſe off the bow-line, and haul in the weather brace, in order to prevent the ſail from fixing itſelf on the ſtay; and the brails ſhall be in the mean while hauled up as faſt as poſſible; for all kinds of manœuvres ought always to be executed with quickneſs and celerity. When, in ſtreſs of weather, you want to ſet a lower-ſail, you muſt begin by hauling its tack aboard, caſing away at the ſame time the weather brace, in order to keep the ſail ſhivering: then immediately after, you will make it faſt; but, let it ſuffice to ſay, that the method of ſetting a lower-ſail is exactly the contrary of what is done in the ſame circumſtance to ſet a top-ſail; which difference ariſes from the diſpoſitions of things, and from the riggings, which are alſo very different.

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The execution of moſt of the manœuvres which are practiſed in a ſhip, either for the diſpoſition of the cables, the effects of the capſtern in heaving up the anchors, or getting in or out the boats; to bend ſails to their yards; take-in reefs; rig the top-gallant-yards, or maſts; put tops to them, or take them off; ſet up ſhrouds, and many other things of this nature; all this, I ſay, will be much better and much ſooner learnt in the courſe of a voyage, than by all that could be ſaid here to give an idea of them. All theſe operations are ſo merely practical, that they muſt abſolutely be ſeen performed in order to be well conceived and underſtood. One ſingle voyage will therefore inſtruct better, in that reſpect, than all that could be written on the ſubject.

END OF THE THIRD PART.

AN

ESSAY

ON

NAVAL TACTICS.

PART THE FOURTH.

On Naval Evolutions.

THIS part of the Manœuvre properly concerns the commanding Officer ſailing at the head of a ſquadron or of a fleet. It may be conſidered as a natural continuation of the evolutions of a ſingle ſhip, ſince it is not poſſible to be a good Commander without being previouſly maſter both of the theory and practice of the movements of every ſingle ſhip in particular.

THE Naval Evolutions have been ſo compleatly treated of towards the end of the laſt century by Father HOSTE, that we may with juſtice declare he has exhauſted the ſubject in the very firſt attempt. Many ſince have, notwithſtanding, undertaken to write on the ſame matter, among whom in particular is to be reckoned Mr. BIGOT DEMOROGUES, Captain in the King's Navy, who has juſt publiſhed an excellent Work on EVOLUTIONS and SIGNALS. Theſe learned Authors, in writing on Naval Tactics, have all contented themſelves with deſcanting very minutely on the various

orders

orders of ſailing of a whole fleet; but none of them have ſufficiently defined that which I would propoſe for the common order of ſailing, I mean the ORDER of CONVOY; as this order appears to me the moſt ſimple and the only one a fleet ought to be in at all times; becauſe, firſt, this order is eaſily preſerved; ſecondly, it cannot be diſcompoſed in twenty out of the thirty-two ſhifts of wind, and is eaſily re-eſtabliſhed in the twelve other changes; finally, it is eaſy to paſs from that order to thoſe proper for the ſecurity of a fleet, in all poſſible caſes, either to preſerve one's ſelf, to attack, or to defend. This is therefore what we are going to endeavour to demonſtrate in this fourth part of our Work. As for the movements of a fleet in the five orders of ſailing, as well as for the changes of ſquadrons in thoſe various orders, we refer to the Treatiſes of Father HOSTE and Mr. DEMOROGUES, contenting ourſelves with ſpeaking of that only which ſeems to us eſſential, and practicable in all kinds of events.

To facilitate the underſtanding of what we have to ſay, we ſhall give the definitions and figures only of the different orders; and dwell upon nothing more than a few particulars which are relative to the three ORDERS, of CONVOY, of BATTLE, and of RETREAT, that we may ſhow young Officers how it is poſſible to paſs from the two laſt-mentioned orders to the firſt which we propoſe, and *vice verſâ*; which will reduce NAVAL TACTICS to the greateſt ſimplicity.

CHAPTER I.

Of the manner of dividing fleets; with obſervations to render it eaſily practicable.

FLEETS, however numerous, ought to be divided into three ſquadrons or diviſions; and theſe again may be ſubdivided according as the ſervice requires; as, for example, when it is found neceſſary

to

to form a detachment of the beſt-ſailing ſhips, either to obſerve the enemy cloſely, to bring him ſooner to action, to diſturb him in his order of ſailing, or to come up with him in a ſuperior number, in order to deſtroy him more eaſily; as again, when, at other times, a certain number is wanted to guard the entrance of a port, or keep the ſea to obſerve what paſſes in the offing.

When the fleet is divided into ſquadrons, each of them has a commanding Officer. The firſt ſquadron, which forms the center diviſion in the order of battle, ought, when the ſailing is divided in three files or columns, to keep its poſt between the two others. The ſecond ſquadron ought, in that caſe, to form the ſtarboard column; and, in the line of battle, is to keep the van or the rear, according to the Admiral's orders, or as circumſtances may require. Then the third ſquadron is to form the larboard column; but, ſhould the three ſquadrons ſail together in two files or columns, that which is the third is to be divided equally between the other two; and when the ſecond ſquadron leads, the third is to be in the rear, ſo that they never can intermix, but always keep diſtinct from one another in the order of battle.

The firſt ſquadron, which is commanded by the Admiral himſelf, ought to carry the mark of diſtinction at the main top-gallant maſt head, where the firſt Admiral carries his own flag or broad pendant; and all the ſhips of that ſquadron are to have common pendants at the ſame place without a vane.

The ſecond ſquadron is to carry the diſtinguiſhing mark at the fore top-gallant maſt head, where the ſecond or ~~Vice~~-Admiral carries his own ~~broad pendant~~ Flag; and all the ſhips under his command are to have common pendants at the ſame maſt's head, but without vanes.

The third ſquadron, in ſhort, is to carry the mark of diſtinction at the mizen top-gallant maſt head, in the ſame form and manner as has been explained of the two former ſquadrons.

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The three ſquadrons of a fleet ought to be equal in point of numbers; and the ſhips ſtronger or weaker, large or ſmall, ought to be diſtributed equally throughout the three ſquadrons, in order that the one may be able to oppoſe the enemy as effectually as the other. For, in certain caſes, it will happen ſo that ſuch ſquadron as was to have the van will needs be forced to be placed in the rear; and when the ſquadrons are of the ſame ſtrength, their ſtations become indifferent, and fewer evolutions are conſequently required; which is always a great advantage in preſence of the enemy. The ſloops, fire-ſhips, hoſpital-ſhips, victuallers, and ſtore-ſhips, are to be poſted to windward of the fleet; becauſe, in that poſition, they can eaſily veer on the ſhips which ſupport them, and are in a better ſituation to obey the ſignals which may be made to them. Beſides, there will always be ſome frigates of war on the wings, to windward of the van and rear of the convoy, to look out, and keep theſe veſſels in their ſtations.

When the fleet ſhall be ranged in order of battle in preſence of the enemy, all the ſhips unfit for action, are to be placed out of the range of the guns, on the other ſide of the enemy, and as far diſtant from the repeating-frigates as theſe repeaters are from the fleet.

The fire-ſhips and frigates are to be to windward, if the fleet in the action has the weather gage of the enemy; but, if the fleet has the lee gage, they are to keep a-head of the Admiral of their reſpective diviſions, no farther than to be able, by tacking, to fetch them eaſily.

In the order of retreat, the fleet being formed on the ſtarboard and larboard lines of bearing, and including between them the obtuſe angle of 135 degrees, the veſſels of the convoy are to keep a league a-head of the fleet, in order not to obſtruct them in their manœuvres.

In the order of convoy in three columns, the Admiral of each diviſion is to have his repeating-frigates a little a-head of his diviſion

to

to windward; and, to leeward, in the intervals of the columns. During the action, they are to be on the beams of their reſpective Admirals, out of gun-ſhot of the enemy, and on the other ſide of him, to repeat the ſignals with promptitude and exactneſs.

ARTICLE I.

Of the order of convoy.

THE order of convoy is that which a fleet holds in making a ſtraight courſe; the ſhips being all in the wake one of another, ſteering on the ſame point of the compaſs, and forming a right line. If the fleet be numerous, they may be divided into three columns, which are to be ranged parallel to each other, that of the Admiral occupying the middle, and ſteering all three the ſame courſe.

THE order of convoy ſhould be formed ſo as to keep the ſhips as much as poſſible cloſe to one another; that they may protect without obſtructing each other in the courſe of their navigation, which ought to be the moſt rapid poſſible.

ARTICLE II.

Of the order of ſailing.

THE order of ſailing is generally held when the enemy is expected to be met with. This order is to be ſuch as may, with the greateſt eaſe and celerity, be changed for that of battle, keeping the fleet at the ſame time as much collected as poſſible, in order that the ſhips may mutually protect and aſſiſt each other, without loſing any thing of their headway; for, it is neceſſary that this order of ſailing ſhould contribute to accelerate the ſteering of the whole fleet.

ARTICLE

ARTICLE III.

Of the order of battle.

THE order of battle is to be preſerved in the preſence of the enemy.

IT ought to be formed ſo that the ſhips may reciprocally protect and ſupport one another; preſerving, nevertheleſs, the neceſſary diſtance for manœuvering eaſily during the engagement, and cannonading the enemy with facility, without expoſing each other, or committing miſtakes while they are engaged.

ARTICLE IV.

Of the ſtarboard and larboard lines of bearing.

THERE are two lines when cloſe hauled, diſtinguiſhed by the *ſtarboard* and *larboard* lines of bearing. The line by the wind on the ſtarboard tack, called the ſtarboard line of bearing, is when the ſhips, whether ſailing or lying-to, are ſo ſituated with reſpect to each other, that the bowſprit of the one ſhould exactly point to the ſtern of the headmoſt throughout the whole line, preſerving all the ſame bearing, and hauling their wind cloſe with the ſtarboard tacks on board.

THE line by the wind on the larboard tack, or the larboard line of bearing, is the ſame with reſpect to the ſhips reſpective ſituation to each other, except they haul their wind cloſe with their oppoſite tacks on board.

THE order of ſailing of a fleet, on one of the lines of bearing, is that which they hold in going from the wind, preſerving the ſame direction, with reſpect to each other, as on one of the lines of bearing. A numerous fleet is divided into ſquadrons; and every ſquadron is ranged in the order of ſailing on the ſame tack as the diviſion of the Admiral, and ſtanding on the ſame courſe with him.

ARTICLE V.

Of the advantages and diſadvantages of fleets which come to action with the lee or weather gage.

THE order of battle is that which a fleet maintains when ranged on a line cloſe by the wind, on the ſtarboard or larboard tack, and all the ſhips lying-to, or ſtanding-on, at a cable's length diſtance more or leſs from each other, in order that, during the action, they may have a ſpace ſufficient for manœuvering, and to avoid running foul on the ſhip a-head, ſhould ſhe ſuddenly have any of her maſts or yards ſhot away, as it is often the caſe in fighting with the ſails filled. We mention a cable's length, or one hundred fathoms between every two ſhips, becauſe that ſpace is ſufficient for manœuvering with facility, and to avoid running foul of the veſſel a-head, by paſſing to windward or to leeward of her, were ſhe unluckily diſabled in the midſt of the fire and ſmoak. Beſides, with this diſtance, the ſhips are always in a ſituation reciprocally to ſupport each other, as the interval is not great, and the line not exceſſively prolonged; for, you muſt take it as a maxim, that there is as much danger in being too much extended as in being too cloſe in the order of battle.

As fleets never ought to engage but in a line, and cloſe to the wind, it reſults that one of the lines muſt neceſſarily be to windward of the other; and that both lines have conſequently their peculiar advantages and diſadvantages reſulting from their reciprocal poſitions in reſpect to the wind. This is what we are going to examine here candidly, in expoſing fairly whatever is favourable or unfavourable in either of theſe two poſitions.

THE fleet which has the weather gage of the other, has the advantage of determining the time and diſtance of the action; they may board if they think proper, and follow the enemy cloſe whenever he gives way; they may eaſily traverſe the enemy's line, ſend fire-ſhips to their diſabled veſſels, and detachments to cut off the van

van or rear of the fleet to leeward; finally, they are never annoyed by the fire or ſmoak, as the wind carries it to the enemy. So much for the advantages which the fleet to windward draws from that poſition.

Now, the diſadvantages of being to windward, are an inability to quit the fight when once engaged, without being obliged to paſs through the enemy's line, which is extremely dangerous; becauſe, being already very much injured ſince they are obliged to fly, they muſt expect to be ſtill more ſo; and, as they have no longer in their power to form the order of retreat, it follows this manœuvre is abſolutely a deſperate one. If the fleet to windward tack all together in order to get off, the line to leeward may do the ſame, after having raked the weather ſhips in ſtays, and follow them on the other tack, with the advantage of having gained the wind of the center and rear diviſions of the flying line. If it blows freſh, it is ſeldom the caſe that the weather ſhips have their lower deck guns ſufficiently elevated; whence it reſults that the ſhip being a little inclined on her ſide, the guns often run out again at their ports, after being fired, which very much retards the ſervice of the artillery, ſince the guns are obliged to be bowſed in again every time for loading. Another diſadvantage is, that ſuch of the ſhips as are ſo diſabled as to be obliged to quit the line, cannot eaſily do it, becauſe in veering, for want of being able to tack, they fall between the two lines, where they are raked a-head, and by that means compleatly put in diſorder. But, ſhould they be fortunate enough to be able to finiſh their evolution, it is ſtill very difficult for them, diſabled as they are, to get to windward of their line; and very often they fall foul of the next ſhips a-ſtern to them, which have it hardly in their power to prevent that accident, on account of the fire and ſmoak, eſpecially if the line is much contracted: and, ſhould theſe perceive it, and try to avoid being run foul of by falling back on their next ſhip a-ſtern, and ſo on thus ſucceſſively; it might reſult that from one to the other a great part of the fleet being obliged to

manœuver, their fire would leſſen, and very often ceaſe, by their covering each other; when the diſorder increaſes, and all is loſt if the enemy take advantage of this critical moment.

But theſe inconveniences may be partly prevented, by having the diſabled ſhips quickly towed out of the line by the boats of the fleet, which, for that very purpoſe, ſhould always be hoiſted out from each ſhip before the engagement begins. Otherwiſe, if the ſhips in the weather line, not being too cloſe, have the neceſſary ſpace to obſerve what paſſes a-head of them, and to manœuver, they ought to range themſelves to leeward of the diſabled veſſel, in order to cover her, and approach nearer to the enemy; all the other ſhips bearing up alſo together to preſerve the line.

The fleet on the lee gage have the advantage of ſerving with facility and effect their lower tiers of cannon, in all weathers proper for fleets to come to action: they can quit the engagement at pleaſure: their diſabled ſhips are at liberty to leave their ſtations without difficulty, if neceſſity requires it; thus they find themſelves under cover by the reſt, where they may ſoon be aſſiſted by the frigates. In this poſition, they can form the order of retreat with more promptitude, or continue the action as long as convenient. In ſhort, the lee line of battle can alſo, if ſuperior in number, double the enemy, by making ſome of the ſhips in the van or rear to tack, and put one of the extremities of the enemy's line between two fires.*

Its diſadvantages are, being very much annoyed by the ſmoak, and a continued ſhower of fire from the wads falling on board, repelled by the wind; which, if not attended to, may be productive of very great accidents. The ſhips of the line to leeward cannot attempt to board thoſe of the other, whatever may be their inclination for it: they can hardly do more than accepting the battle, without

* And, if they are formed in time, they have the advantage of cannonading the enemy while bearing down to the attack.

without being able to determine either time or diſtance. It is but with a great deal of difficulty they can avoid being boarded, or prevent their line being broken, if the weather ſhips are bent upon doing it; and their fire-ſhips very ſeldom are of uſe.

It reſults from all that has been ſaid, that the diſadvantages of the weather line are leſs numerous than thoſe of the lee; but, likewiſe, that they are more dangerous; and the advantages of that line are, in general and in particular, more eſſential, eſpecially when ſtronger by a few ſhips; for, it is only neceſſary to keep in the line a ſufficient number of ſhips to oppoſe the ſame number in the line to leeward of them, and form a detachment of the ſurplus to attack the ſhips of the rear of the enemy, and, by bringing them between two fires, oblige them to give way. Then, theſe ſhips puſhing forward from one to another, and being joined and aſſiſted by ſuch of their comrades to windward as have juſt got rid of their opponents, will ſoon be enabled to put the reſt in confuſion. I, therefore, conceive it is extremely advantageous to have the weather gage, and that, unleſs compelled by ſome very unfortunate circumſtance, a fleet ought not abſolutely to accept the battle while the enemy has the advantage of the wind.

ARTICLE VI.

Of the order of retreat.

The order of retreat is never formed but in preſence of the enemy, and when he is abſolutely too ſtrong. That order ought therefore to be ſo formed, that the retreating ſquadron may have at the ſame time the greateſt poſſible force to oppoſe to the purſuing fleet; in order to put the ſhips of war, and the convoy, if there be any, in the moſt advantageous poſition againſt the attacks of a victorious foe, and, at the ſame time, to fly with celerity and without breaking, in oppoſing every where a ſufficient reſiſtance to prevent the fine ſailing chaſers of the enemy from penetrating. The retreating fleet muſt be able alſo with promptitude, and without confuſion,

confuſion, to paſs from their preſent order of retreat to that of battle on both tacks.

THE order of retreat is that which holds a fleet flying before the enemy, the ſhips being ranged on the ſtarboard and larboard lines of bearing, and forming with thoſe two lines an obtuſe angle of 135°, the Admiral, or the largeſt ſhip, being at the angular point; ſo that the veſſels on the ſtarboard wing of the ſhip at the angle will be ranged in order by the wind on the larboard line of bearing, while thoſe on the larboard wing will be cloſe hauled on the ſtarboard tack and line of bearing.*

ARTICLE VII.

Of the naval ſquare.

Fig. 21ſt. (EVOL. PL. II.) *Order of ſailing in three columns, the ſhips being cloſe hauled on the larboard tack, the columns abreaſt of each other.*

LET the ſquare ABCD be formed and traced on the middle of the quarter deck; and let the line EF be drawn alſo, which will divide the ſhip equally in two, preciſely in the direction of her keel, with the point E towards the head: then, drawing the diagonals AC and AB, theſe two lines will ſhew the direction on which the ſhip will lie after going about from the ſtarboard or larboard tacks, running on GE; for, the angles DGE and CGE are each 135°, or twelve

* In Fig. 1ſt (EVOL. PL. I.) ABC ſhews the angle of retreat and the ſhips on the two lines of bearing, ſailing right before the wind W; the convoy are included between the wings AB and AC, that they may be protected from the purſuing fleet: one view of this plate will, it is apprehended, ſerve to give a perfect idea of this order.

N. B. Neither this note, nor the plate which refers to it, are to be found in the original of Mr. BOURDE': they are both the product of an Engliſh Officer, a great admirer of our French Author, and who, with ſome more Plates hereafter to come, communicated them to the Publiſher as an illuſtration not unneceſſary to the underſtanding of the text; wherefore we have given both the note and the plate acceſs here with pleaſure, and numbered the figure of this plate, 1, that it ſhould not interfere with Mr. BOURDE's original plates, the next of which bears N° 21.

twelve points of the compaſs, equal to the two courſes when cloſe hauled with the ſame wind W: ſo that AC will be the larboard diagonal, becauſe the ſhip will have her larboard tacks on board, after ſtaying and running on the courſe which that line indicated before her going about; and BD will be the ſtarboard diagonal, becauſe the ſhip will have the ſtarboard tacks on board in ſailing on the direction deſigned by that line before the evolution.

FOR greater conveniency, let the two lines GH and GI be drawn, making with GE an angle of 67°, 30′, equal to ſix points, on which, admitting what is commonly practiſed, the ſhips are always ſuppoſed to lie, when cloſe hauled; for, ſhips always ſhould, for greater velocity, be within 79° only; or, when keeping more to windward, 55°, as has been ſhewn in the firſt part of this work.

WHEN, being cloſe hauled, you wiſh to keep your ſhip in the line of the wind, you ſhall continue her exactly in the tendency of GH or GI; but if you wiſh to have it exactly on the beam, you muſt keep her in the bearing AB or DC.

THIS figure is extremely convenient for the Officer of the watch; for whenever he wiſhes to know if he is in his poſt, in the order of convoy cloſe hauled, or large, he will be able to ſee from the points F and E if the ſhips of his column anſwer in the direction of his courſe FE, while the line AB or DC will indicate to him thoſe which ought to be on his beam in the other columns.

Fig. 22d. (EVOL. PL. III.) *Order of ſailing in three columns, cloſe hauled by the wind; the columns coinciding in the direction of the wind, in order to beat to windward with greater facility.*

IF the fleet is in three columns cloſe hauled to ply to windward, every ſhip will be obliged, for greater celerity in the evolution, in ſucceſſion, to hold herſelf in the direction of the wind, with reſpect to the veſſels which are to coincide with her in the other columns, which are to windward or to leeward; and the lines GH or GI, from the point G, will ſerve for the Officer of the watch to ſee if he

is

is in his poſt; and he will be able to diſtinguiſh, at the ſame time, if the ſhips of his column correſpond with his own directions G E and G F.

Fig. 23d. (Evol. Pl. IV.) *Order of ſailing in three columns, on the larboard line of bearing, the ſhips being cloſe hauled on the other tack.*

If the fleet, being in three columns, keep all together the wind on the other tack, the ſhips being in the principle exactly abreaſt of each other, the diagonals from the point G will ſerve the Officer of the watch to ſee if he is in his poſt: for, the ſhips of his column ought to anſwer one another in the direction of one of the diagonals A C or B D, while thoſe of the other columns will be found directly in the bearing B D or A C.

Fig. 24th. (Evol. Pl. V.) *Order of ſailing in three columns, on the ſtarboard line of bearing, the fleet plying to windward, and the ſhips going about ſucceſſively when the columns are right abreaſt one of another.*

If the fleet is in three columns, beating to windward, the van ſhips exactly abreaſt of each other (inſtead of being in the direction of the wind, as we recommend it to be done in ſuch a caſe), the van K of the lee column having tacked, the van L of the center column is to ſtand on, till he brings the headmoſt ſhip K of the lee file (which is on the other tack), in the direction of the diagonal B D to leeward of him: then he is to heave in ſtays, while the leading ſhip M, of the weather column, ſtands on till ſhe brings in the direction of B D the headmoſt ſhip L of the center file, which is alſo in the ſame bearing with reſpect to K, the van ſhip of the lee column, ſince they are both on the other tack; and then ſhe is to tack like the other two, and the three ſquadrons will follow, exactly in ſucceſſion, the flag Officer of their reſpective diviſions.

ARTICLE VIII.

Of the counter-march, or manœuvre in ſucceſſion.

The counter-march, or what in the Britiſh Navy is called manœuvre in ſucceſſion, is when a fleet, ranged in one of the orders

of

of ſailing, and ſtanding on in the ſame line, cauſes the ſame manœuvre to be performed ſucceſſively by all the ſhips, as they arrive at the ſame point of the wake of the van ſhip of the whole fleet in one ſingle line, or of the van ſhip of each particular diviſion, when divided into ſquadrons: ſo that a fleet tacks or veers in ſucceſſion, bears away or comes to the wind in ſucceſſion, when all the ſhips of every line execute one after another the ſame movement, on the ſame point of the wake of the leading ſhip of the file.

General obſervations on ſucceſſive evolution.

When the ſhips are at a hundred or two hundred fathoms diſtance from each other, and the next ſhip a-head heaves in ſtays, it will be neceſſary that the ſhip which is to tack immediately after in her wake, ſhould always, and in all caſes, when come to a certain point, overſhoot a little that point, that ſhe may not incommode the ſhip a-head of her, and which is head to wind in her manœuvre; for, very often, it happens that the hundred or two hundred fathoms are ſooner run over, than the veſſel a-head has been able to fill her ſails on the other tack.

REMARKS.

If a ſhip miſſes ſtays, when a fleet or a column is about getting on the other tack in ſucceſſion, ſhe is immediately to file again on the ſame tack and make ſail with all poſſible diſpatch, taking care to keep as cloſe as ſhe can to the wind, and not to fall off to leeward too much. By theſe means ſhe will get a-head, and to windward of the ſhips which follow and are a little to leeward of her; or they will go and perform ſucceſſively their evolutions in the wake of the ſhips which are already on the other tack, in ſtanding on a little farther than they would have done, if the ſhip a-head had not miſſed ſtays.

By theſe means the movements of the fleet will not be diſturbed, which is of very great conſequence; becauſe, the ſhip which has failed in her evolution, will therefore pay more attention to her manœuvre, in order to avoid running foul of her companions. She will find herſelf to windward of thoſe which follow her, and be conſequently able to return ſooner to her ſtation, by making all poſſible ſail to windward of her line.

Such a circumſtance as this is ſufficient to make Officers ſenſible how important it is for them to pay a proper attention firſt to their manœuvre, that their evolution may not fail, and then to that of their ſhip a-head, that they may be able to act according to her movements in all poſſible caſes, in order to avoid thoſe accidents which may happen from a want of attention in thoſe who have the management of ſhips in a ſquadron.

CHAPTER II.

Of the manner of forming orders in general.

ARTICLE I.

How to form the order of convoy on a line.

To form the order of convoy, when the fleet is in no particular order of ſailing, the leading ſhip is to veer ſufficiently for the others to get in her wake and ſteer the ſame courſe ſhe holds. Generally, it is the commanding Officer who takes this poſt, when the ſquadron is not numerous.

That the order may be the ſooner formed, every ſhip of the fleet or ſquadron ſhall chaſe at the ſame time that which is to be a-head of her in the line, taking care to manœuver in ſuch a manner as to avoid running foul of thoſe which croſs her fore-foot in endeavouring to join their leaders in the file. Therefore, ſuch as are

to

to leeward of others ſhall take care not to perſiſt obſtinately in weathering them; but, they muſt back, or go a-ſtern if neceſſary, by keeping away a little more. Such as ſhall already be in the column, and are to be more a-ſtern, muſt bring-to till they are in their poſts, or ſtand on under a very eaſy ſail, that each ſhip in particular may contribute to the celerity of forming the order.

ARTICLE II.

To form the order of convoy in three columns.

To form this order with celerity, the leaders of each of the three diviſions are to poſt themſelves in a line right abreaſt one of another: and, in order to render the formation of the order more eaſy, they muſt take care to keep a proper diſtance between themſelves, according to the length of the columns, which will accelerate the progreſs of the diſpoſition. Then every ſhip of each particular ſquadron, chaſing that which is next a-head of her in the file, will come and take their ſtations a-ſtern of another at the rear of the leading ſhip of the diviſion, and ſteer directly after her.

This order, which in the practice is very eaſily held, has the advantage of keeping the fleet cloſe and connected, without cauſing any delay in its progreſs towards the intended deſtination; becauſe the beſt ſailers can regulate their velocity by that of thoſe which are inferior to them in ſailing, and, *per contra*, theſe on the other hand may, with a little attention, carry as much ſail as the weather will admit, by which means all imaginable courſes may, without breaking, be ſteered.

ARTICLE III.

To form the order of ſailing in one column.

To form this order, the ſhip which is to be farthermoſt of all to leeward is to bear away, if too much to windward, and ſteer the

courſe which is directed to her; then all the other ſhips, chaſing each in particular that which is to be a-head of her in the line of battle, will come and take their poſts to windward, on either of the two cloſe hauled lines of bearing on which the order is to be formed; ſo that all the ſhips being now in their proper ſtations, they will find themſelves ranged what is called *chequer-wiſe*,* and the whole fleet will be in compleat order.

Another Method.

The leading ſhip, being to windward of all, is to keep her luff under an eaſy ſail, while all the reſt make all poſſible ſail and turn up to come and take their poſts in her wake: when each of them has thus attained her ſtation, the fleet may ſteer what courſe may be thought proper, and, by theſe means, they ſtill get to windward in forming.

ARTICLE IV.

To form the order of ſailing in three columns.

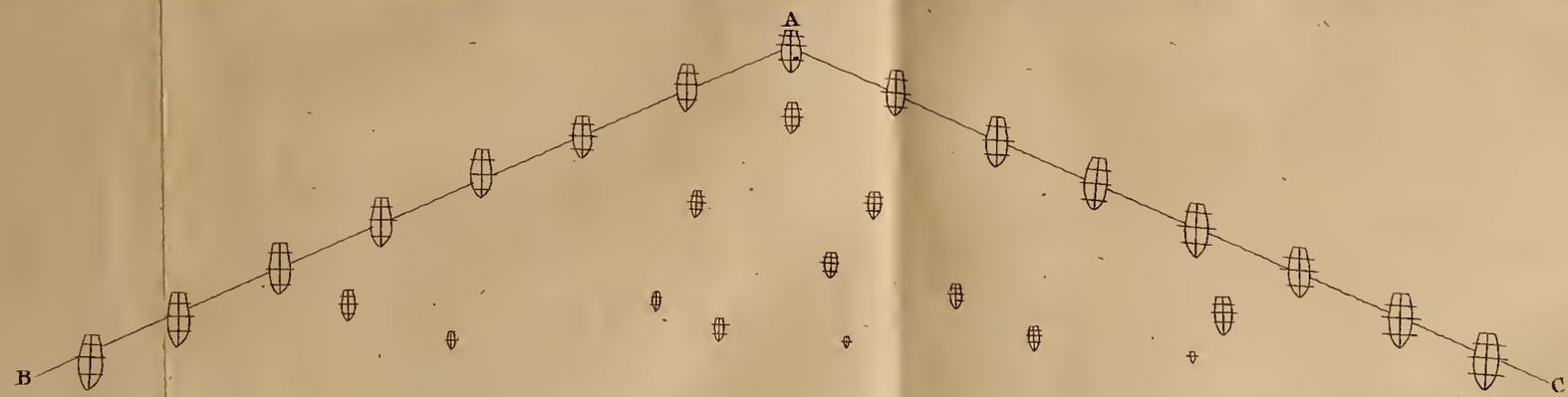
If the fleet be conſiderable, or if the Admiral wiſhes it to form the order of ſailing in three columns, the three leading ſhips of the diviſions are to take their poſts a-breaſt of each other, in keeping their wind under an eaſy ſail, that is to ſay, perpendicularly to their columns when they ſhall be formed. Then, the ſhips of each ſquadron, making ſail, will come and range themſelves a-ſtern of them in their proper ſtations in the file, and keep the ſame courſe as they; preſerving, with reſpect to the direction of the ſhips one from another, the ſame line of bearing on which the order ſhall be formed, whatever may be the courſe the fleet is to ſteer.

OBSERVATIONS.

As this manner is not the moſt favourable for plying to windward, it will be neceſſary that the two weather-columns ſhould make

* The French call this order *en échiquier*, which, for want of a more proper term in Engliſh, we have rendered here *chequer-wiſe*.

Fig:1st.



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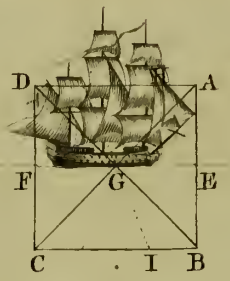
EVOLUTIONS Pl. II.

Fig. 21st



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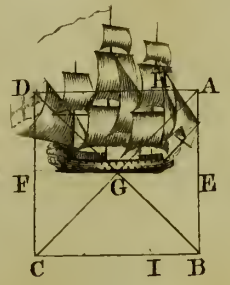

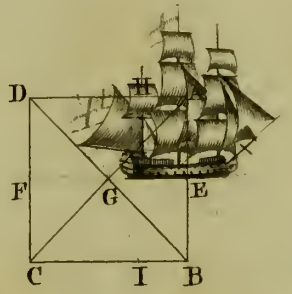

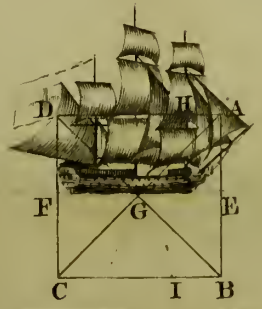

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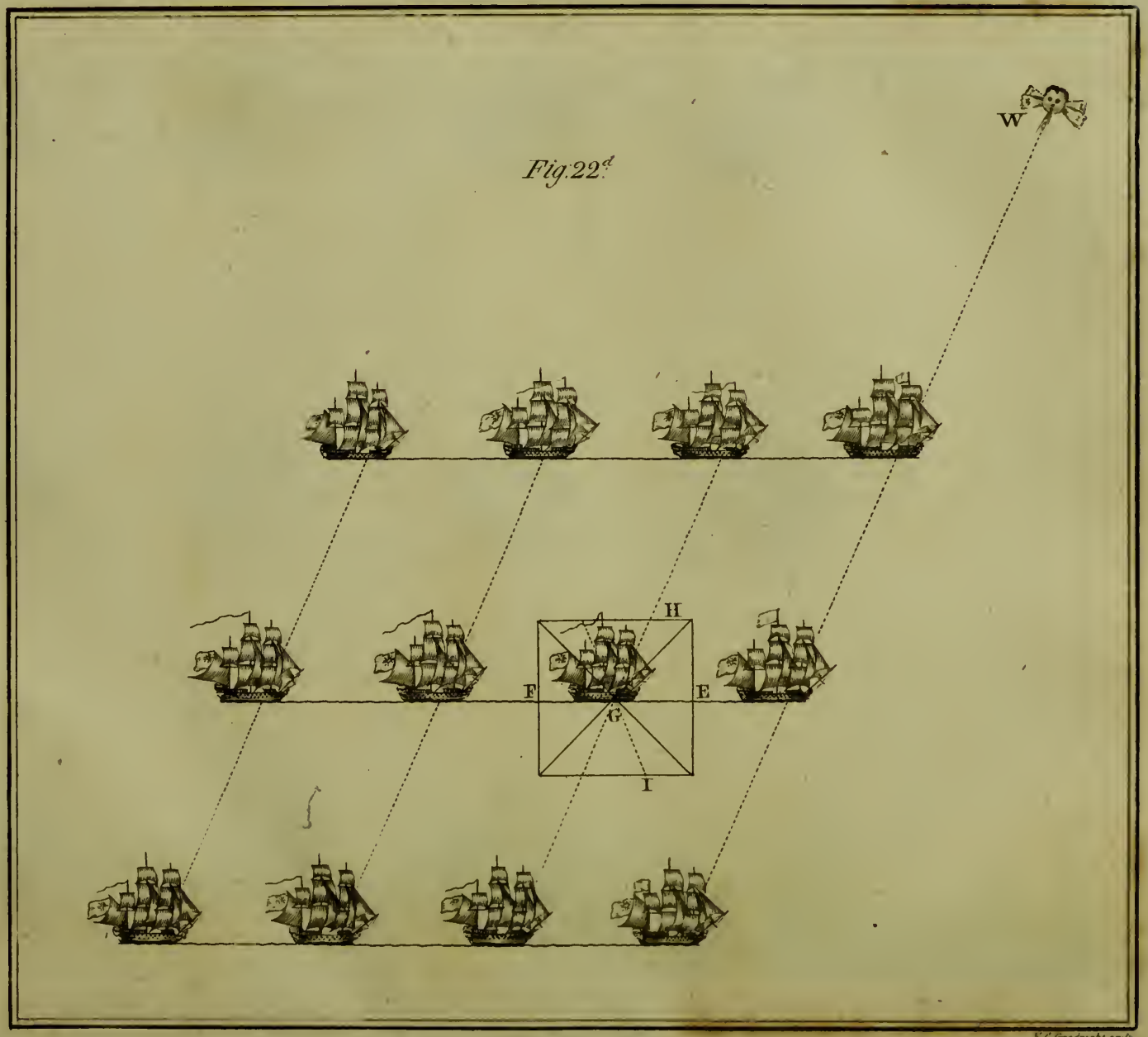

S.C. Goodnight sculp.

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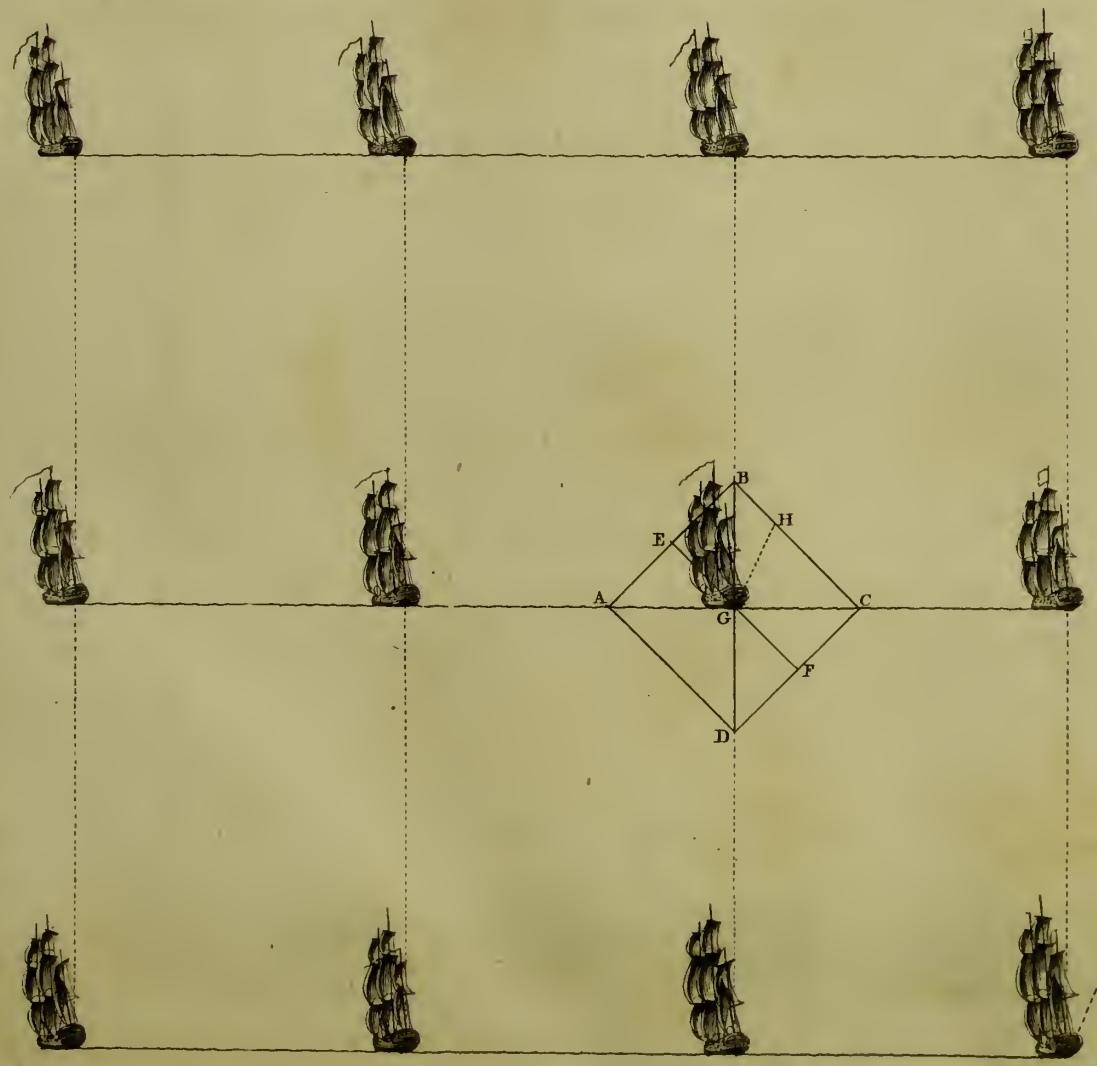
Fig:23.[1]



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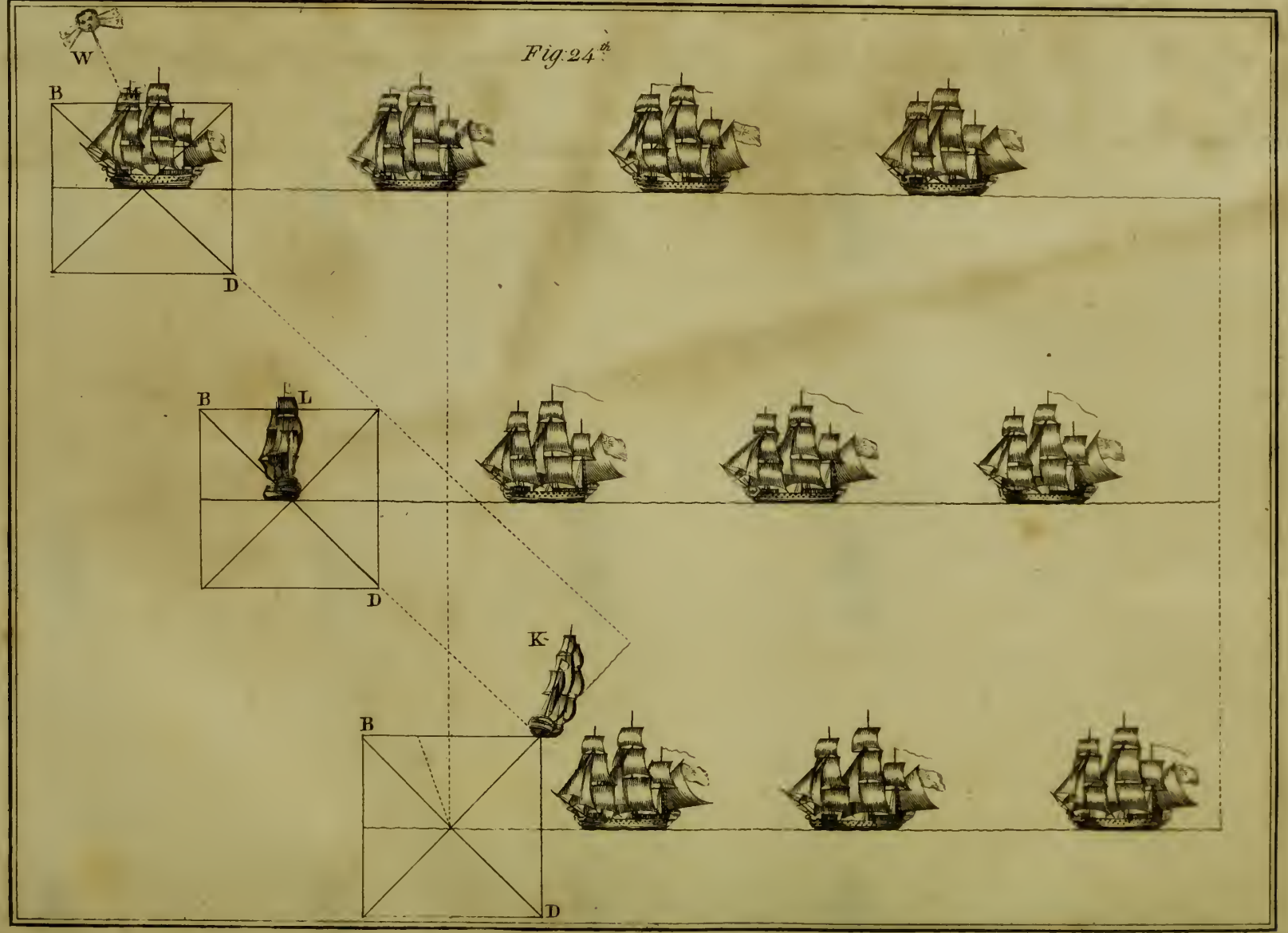

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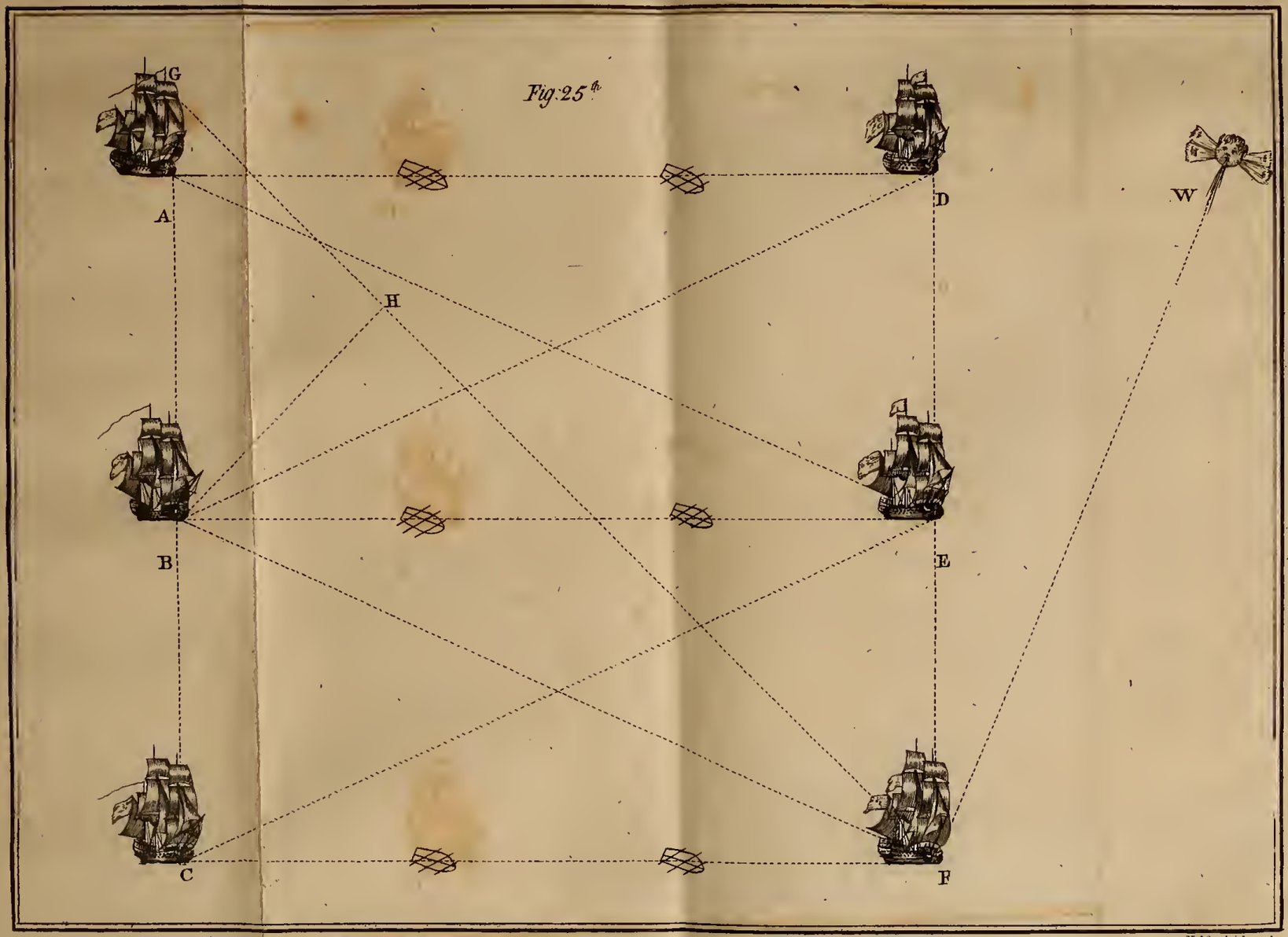
EVOLUTIONS Pl.VI.



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make ſail till they are out of the direction of the wind of the file to leeward, which, till this is effected, is to leſſen its rate of ſailing.

ARTICLE V.

A principle for finding the diſtance of the columns as ſoon as their length is known.

Fig. 25th. (EVOL. PL. VI.) *Order of ſailing in three columns on the larboard tack; the ſhips ſtanding on large all together.*

To determine, in either of the orders of ſailing, the diſtance of the columns, and the poſt of each ſhip, the number of veſſels which compoſe it, and the length of each column, muſt be known. Then raiſe CG perpendicular to CF, making them equal to each other, in order to draw FG, that you may make FH=CF; and thus you will have GH as the diſtance of the columns from A to B, and from B to C: ſo that the lines AE and BF, in the order of ſailing, being drawn from the rear of the weather column to the van of the leeward column AD, will be perpendicular to the direction of the wind w.

DEMONSTRATION.

SINCE the van F and the rear B are equally to windward, BF is perpendicular to the courſe of the wind w, of which the angle BFC, equal to the angle BCF, is 22°, 30′; therefore ECF is alſo the half of the angle CFG of the right angled iſoſceles-triangle CGF: therefore the triangles BHF and BCF are ſimilar and equal, and therefore the line BC is equal to BH or HG; q. e. d.

COROLLARY.

IT follows that, to have the diſtance of the columns of which the length is known, the ſquare of the length of one column muſt be taken, and then double it, in order to have the ſquare of the hypothenuſe FG of the right angled iſoſceles-triangle GCF: then, from

from that ſum take the ſquare root by decimals, in order to come as near it as poſſible: then, taking from that root the length of one column, what remains ſhall be the diſtance between the columns.

For example; in fig. 25th there are four ſhips in a column at one hundred fathoms diſtance from each other, and forty-ſix fathoms are allowed for the length of each ſhip from the jib boom end to the fly of the enſign; ſo that every column will be 484 fathoms long, the ſquare of which will be 234256, and the double 468512; which will give the neareſt root, 684 fathoms, from which taking 484, there will remain 200 fathoms for the diſtance requiſite between the columns. This rule will ſerve as a formula for all the files, however long they may be.

ARTICLE VI.

To form the order of battle.

To form the order of battle, the ſhip which is to lead muſt bear away till ſhe is to leeward of the reſt of the fleet, when ſhe will haul cloſe by the wind under her three top-ſails; while all the other ſhips, chaſing each before them thoſe which are to be a-head of them in the line, ſhall come with all poſſible expedition to take their ſtation a-ſtern one of another, and keep their luff directly in the wake of their ſeconds a-head.

Every ſhip ſhall take care to keep exactly at a cable's length, that is to ſay, one hundred fathoms diſtance from the ſhip a-head of her: and to preſerve that regularity in the diſtance, the beſt ſailers muſt have the attention to moderate their head-way, and make it conformable to that of ſuch as do not ſail ſo well, which on their ſide are not to neglect what can poſſibly accelerate their progreſs, that the diſpoſition may be uniform, and the diſtance between each ſhip ſtrictly equal throughout the whole extent of the line of battle.

ARTICLE

ARTICLE VII.

To form the order of retreat.

THE Commander in Chief, or the heavieſt ſhip, which ſhall be deſtined to make the angular point, is to bring-to a little to leeward of the other ſhips of the fleet, which by keeping away will come next and place themſelves in their poſts, at equal diſtances on the wings; ſo that thoſe to the left of the ſhip at the angle, are to range themſelves cloſe to the wind on the ſtarboard tack, with reſpect to one another, and thoſe on the right of the ſame ſhip are to put themſelves in order on the larboard tack: when the two leeward-moſt ſhips, and the moſt diſtant from the ſhip at the angular point, ſhall be at their poſts on the different tacks forming the van of each wing, the order is finiſhed, and the fleet may ſteer the ſame courſe with the Admiral. The heavy going ſhips ought always to make every effort to encreaſe their rapidity of ſailing, and ſuch as have of themſelves a ſuperior progreſſive movement are to regulate their ſail by the velocity of the reſt, taking the greateſt care not to ſwerve from the order.

A general Obſervation.

IN all caſes and in all circumſtances, the ſhip a-ſtern is to keep an eye on the veſſel a-head, in order not to conſtrict her manœuvres, and to avoid running foul of her; therefore, it is the buſineſs of the Officer of the watch always to manœuver conformably to the movements of the ſhip a-head of his, without attending to her which is a-ſtern, whoſe buſineſs it is to have likewiſe the ſame attention to the veſſel a-head of her.

THIS mode of keeping a look out, and of maintaining the ſtation one is in, facilitates the movements and prevents accidents; becauſe, as every one obſerves the ſhip a-head of him attentively, it follows

that

that all the veſſels execute their evolution in conformity to that which is a-head of them, and thus no miſtake can happen. On the other hand, general evolutions never take place till after all the fleet, or diviſion, which is to make the movement, is informed of it by a ſignal, which is always repeated by the frigates and the flags of the diviſions.

CHAPTER III.

Manner of changing orders.

ARTICLE I.

To change from the order of convoy, in one line, to the order of battle, continuing on the ſame tack.

THE headmoſt ſhip is to haul cloſe by the wind on the ſame tack, and the reſt of the fleet are to make the ſame movement ſucceſſively, obſerving not to be more or leſs diſtant from one another than the length of a cable, in order that during the firing in the engagement the ſhips may have the neceſſary ſpace to manœuver, and avoid the accidents which the loſs of maſts or yards may occaſion. Whenever this method ſhall be obſerved, the line of battle cannot miſs being ſoon formed.

ARTICLE II.

To change from the order of convoy, in a line, to that of battle on the other tack.

THE headmoſt ſhip is to veer and to come to the wind on the other tack: then, all the veſſels of the fleet are to perform the ſame manœuvre in ſucceſſion. By this method the order cannot fail being very rapidly changed.

Another

Another Method.

AFTER having formed the order of battle on the ſame tack, as has been ſhewn before, the van ſhip is to tack; and all the ſhips of the fleet are to follow in ſucceſſion, to form the order of battle on the other tack.

OBSERVATION.

IF you are ſteering a courſe in the order of convoy, four points large, the order of battle on the other tack may be formed at once, by all the ſhips veering or ſtaying together.

ARTICLE III.

To change from the order of convoy, in three columns, to the order of battle on the ſame tack.

WHEN the fleet ſhall have the wind on the beam, between cloſe hauled and eight points large, the ſhips of the leeward-moſt column are all to bring-to at the ſame time, while thoſe of the other two columns, continuing their courſe, will come and place themſelves on either of the cloſe hauled lines of bearing of the column which is lying-to, in obſerving that the weather column is to make all poſſible ſail; and when come to that point, the headmoſt veſſel of it is to take the lead in hauling cloſe by the wind, with every thing ſet: when that is done, all the ſhips of that column are to follow in ſucceſſion.

WHEN the center ſhip of the weather file ſhall have paſſed the point where the leading ſhip of her diviſion began the evolution, the van of the middle column which is lying-to on the ſtarboard or larboard line of bearing (which ever of them it may be that they are going to ſteer on), and conſequently in the wake of the weather column which is filing off, muſt now file and ſtand on by the wind,

as muſt alſo all the other ſhips which are to follow her ſucceſſively, keeping away large one after another on their firſt courſe, to get into the wake of their leader. The lee column is to follow in the ſame manner, after having filed when the center ſhip of the middle column is cloſe by the wind; and, when the laſt ſhip of that file is in her poſt, the evolution is finiſhed, and the order of battle formed.*

If the wind be more than eight points, or right aft, the column which is to form the van guard in the order of battle, is inſtantly to begin manœuvering, by hauling ſucceſſively the wind with all ſails ſet; while the two others, continuing their courſe, will put themſelves ſucceſſively by the wind, on one of the two lines of bearing which is to be followed, and in the wake of the weather column which is filing off, when, and at which point, they are to make the ſame movement in ſucceſſion, as ſoon as their leaders ſhall have arrived there under a very eaſy ſail, in order to compleat the line of battle.

If

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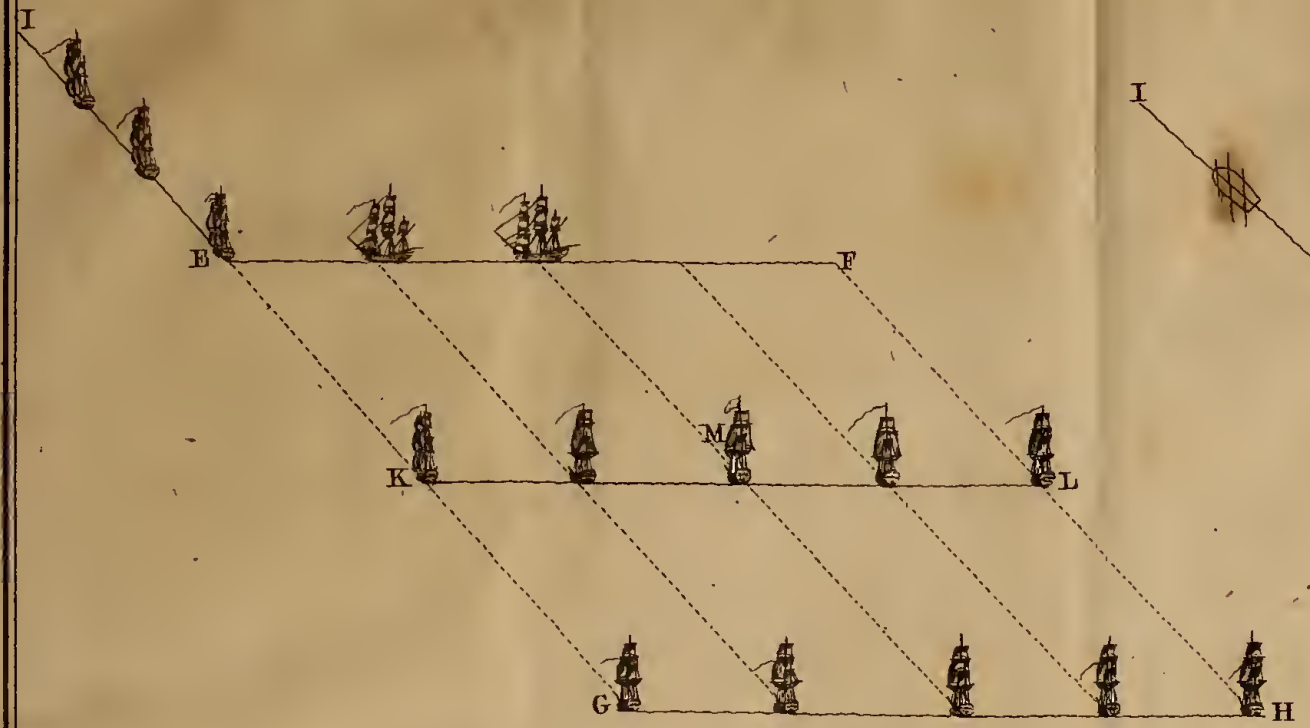
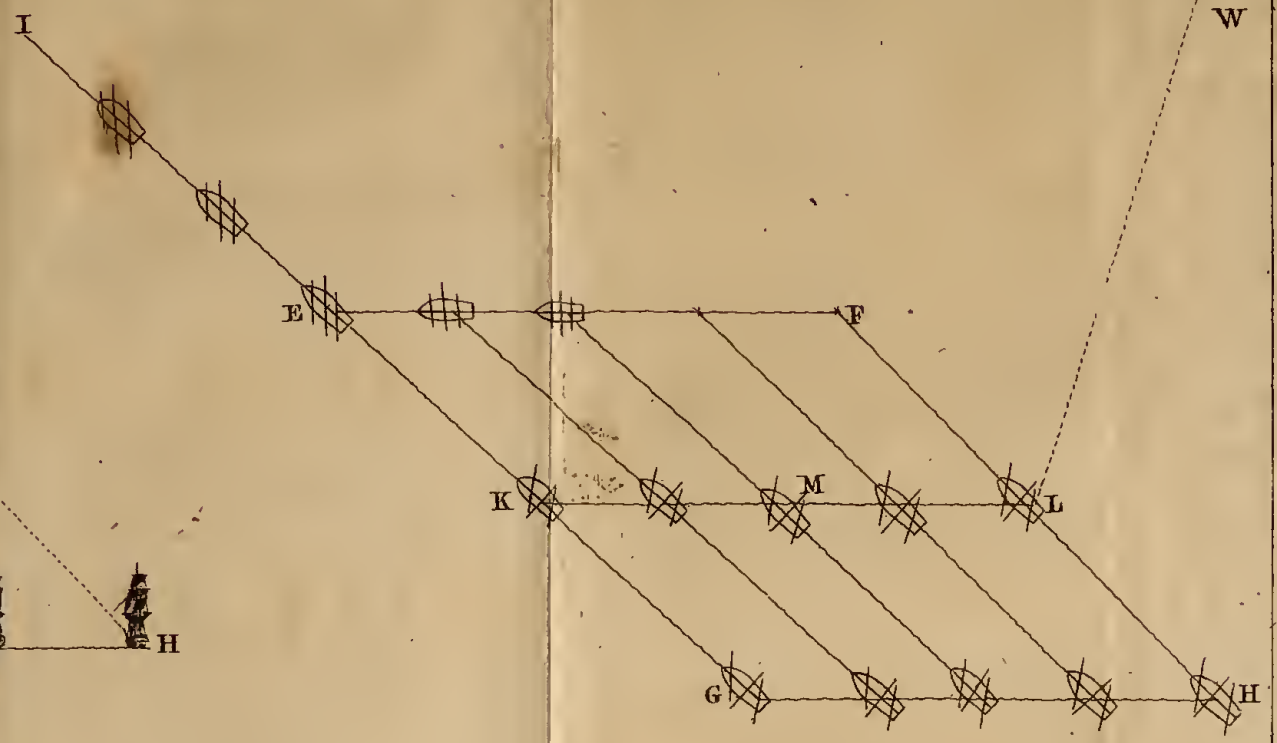
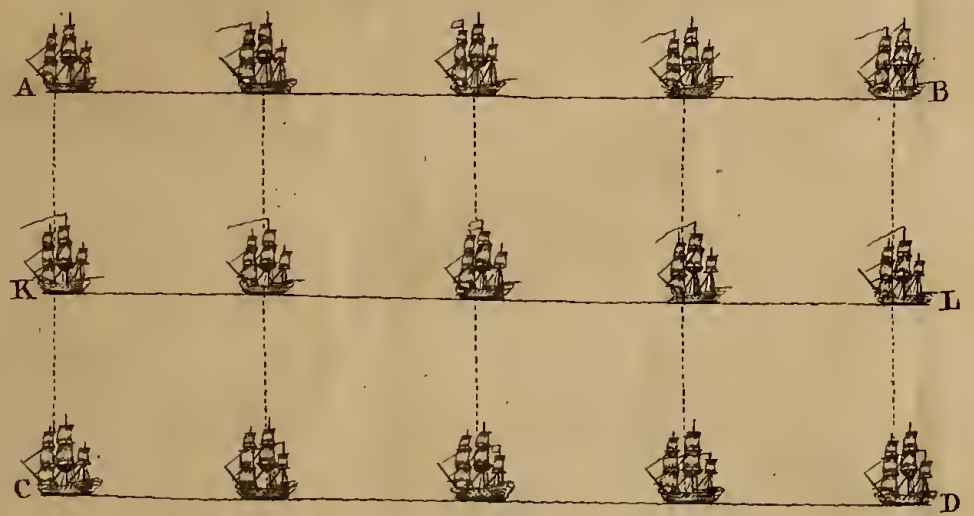
* To illuſtrate this by a figure, let us ſuppoſe A B C D (*Fig.* 2, Evol. Pl. VII.) to repreſent a ſquadron in the order of convoy in three columns, which is their firſt poſition; then E F G H I will ſhew the ſhips in the ſecond poſition, when the middle column has brought-to on the leeward-moſt line of bearing from G to K and from H to L, while the veſſels of the weather file ſtretch on and haul their wind in ſucceſſion at the point E, to form the line of battle from E to I: E ſhews the center ſhip of the weather column having hauled by the wind, K the leading ſhip of the middle file, filing and ſtanding-on cloſe hauled, while the remaining ſhips of her diviſion bear up ſucceſſively on their firſt courſe, from L to K, to haul their wind in ſucceſſion, at the point K, in the wake of their leader: and, when the center ſhip M, of the middle column has hauled her wind, the van ſhip of the lee column at G is to file, and the others are to go through the ſame manœuvre as the middle file, to compleat the order of battle.

If the wind be exactly eight points large, the two lee columns are to bring-to, both at the ſame time, and obſerve they are not to file, nor come ſucceſſively to the wind, till the center ſhip of each column to windward has filed off to follow the leader.







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If the fleet be close up on a wind, the weather column may lie-to with their main top-sails to the mast, while the two other files, having tacked both together, will come and station themselves in their wake, by running two points large on the other tack, in order by both columns to heave again about afterwards together and file, after having posted themselves in the wake of the column which is lying-to.*

You may get somewhat more to windward, by making the two lee columns keep close by it as soon as they shall be both on the other tack, while the vessels of the weather one shall continue to keep their wind; and as soon as they shall have in their wake those of the other two columns, they will all at once heave in stays and follow the van division.

Another method again may be made use of, *viz.* by making the middle column lie-to, while the weather one shall take post in the van by bearing away two points large, and the lee file shall run also two other points large on the other tack, after having heaved about, both at the same time, to take their station in the wake of the column lying-to, which is itself now to tack with all the others together.

In short, when the case is urgent, you may make the lee column bring-to, while the two weather files shall run together two

* That the idea of this movement may be better elucidated, let us suppose ABCDEF (*Fig.* 3, Evol. Pl. VIII.) to represent the order of convoy in three columns; then, the weather column A B having brought-to, the middle and lee columns C D and E F tack all together to fetch the wake of the file to windward, which is executed by the middle column running two points large on the parallels between C K and C D, till they arrive all together at the points K, L, M, G, in the wake of the weather column, where they are all at the same time to heave about and bring-to on the other tack, to wait the arrival of the lee column, which is by this time to have reached the points *n*, *o*, *p*, *i*, in preserving their course towards the extremity of their parallel N, O, P, I, where they are to tack to compleat the order of battle, as is exhibited from A to I.

points large, to take one after the other their poſt a-head of the column lying-to.

ARTICLE IV.

To change from the order of convoy, in three columns, to the order of battle on the other tack.

The ſquadron might be put firſt in order of battle, on the ſame tack; then, making the veſſels ſtay in ſucceſſion, they would be all at once in order of battle on the other tack. But, as this method might be thought too long, the time of evolution may be diminiſhed, by making the two weather columns bring-to when the wind blows between the direction of cloſe hauled and eight points large, while the ſhips of the lee column ſhall veer in ſucceſſion and keep their wind on the other tack. And, when the center ſhip of that column ſhall have filed off, thoſe of the middle column ſhall file all at the ſame time, the leader of that column running exactly with the wind right aft, with the remainder of his ſhips following him in ſucceſſion, till they are in the wake of the column which is filing off. Then, that leader of the middle column is to haul by the wind along with all the ſhips of his diviſion, which are to follow him in ſucceſſion; and when the center ſhip of that column ſhall have alſo filed off, the weather ſquadron is to file in turn, go through the ſame movement, and thereby to compleat the formation of the order of battle.

If you are cloſe up on a wind, the line of battle on the other tack may be formed by the weather column heaving in ſtays in ſucceſſion, and keeping the wind on the other board, while the two other ſquadrons, continuing their courſe, will come and execute the ſame manœuvre in ſucceſſion, each of them at their ſeveral points of the wake of the van diviſion, in order to compleat the order of battle.

ARTICLE

ARTICLE V.

To change from the order of convoy to that of retreat.

If the fleet or ſquadron be in the order of convoy in one line, they are firſt to form in the order of battle on the ſame tack; then the van ſhip is to bear away four points, and all the fleet following cloſe hauled, they will come to file off in ſucceſſion at the ſame point in the van ſhip's wake, till the center ſhip arrives at the angle where the evolution began. Then, the order of retreat will be formed, and any courſe whatever may be ſteered, ſince the two wings will be equal and in order on the ſtarboard and larboard lines of bearing, forming conſequently between them an angle of 135 degrees.

If the fleet be in the order of convoy in three columns, they are to form the order of battle on the ſame tack, as has been ſhewn before; then the van ſhip is to bear up four points, and all the fleet, following by the wind, ſhall perform the ſame manœuvre in filing off in ſucceſſion, as far as the center ſhip of the column, in order to form the order of retreat on the two cloſe hauled lines of bearing.

ARTICLE VI.

To change from the order of battle to that of retreat.

This evolution is the ſame as the preceding; for the head ſhip is to bear away four points, and half the fleet are to perform the ſame manœuvre in ſucceſſion as far as the center ſhip, which is to form the angular point in the order of retreat, which will be then formed in two wings ranged on the two cloſe hauled lines of bearing of the ſtarboard and larboard tacks, according to the definition.

ARTICLE VII.

To change from the order of battle to the order of convoy, in one line, on the ſame tack.

THE van ſhip is to bear away as far as the intended courſe, and the reſt are to execute the ſame manœuvre in ſucceſſion; ſo that, when the rear ſhip ſhall have made the ſame movement, the evolution will be compleated, and the order of convoy formed on the ſame tack.

ARTICLE VIII.

To change from the order of battle to the order of convoy, in one line, on the other tack.

THE van ſhip is to tack and run one point large on the other ſide, till ſhe can bear up as far as the courſe which the fleet is to hold, by paſſing not a-head but under the ſtern of the rear ſhip. All the ſhips are to perform the ſame manœuvre at the ſame points, to change the order and get upon the other tack, all of which will be compleated when the laſt veſſel ſhall ſteer her courſe in the wake of the ſquadron.

OBSERVATION.

THE van ſhip, inſtead of tacking, may veer and run a little time before the wind, before getting on the other tack: then ſhe will heave to the wind on the fleet's courſe, without fear of breaking through the rear. This movement is ſhorter, and to be preferred, ſince the order of convoy is never held to keep by the wind.

ARTICLE IX.

To change from the order of battle to the order of convoy, in three columns, on the ſame tack.

THE three van ſhips, or leaders of the columns, are to bear up together and ſteer on the intended courſe of the fleet; then the ſhips of

of each ſquadron are to execute the ſame manœuvre in ſucceſſion, in following the ſame direction; ſo that the three rear ſhips, veering at the ſame time in the wake of their reſpective columns, will compleat the evolution.

OBSERVATION.

THE columns will find themſelves too diſtant from each other; but as there is nothing which diſturbs them, and they have the wind right aft or very large, it will be eaſy for them to cloſe as much as may be neceſſary.

ARTICLE X.

To change from the line of battle to the order of convoy, in three columns, on the other tack.

THE three van or leading ſhips of the diviſions are to heave in ſtays at the ſame time, and bear away on the perpendicular of the wind on the other tack: then the ſhips of each ſquadron are to perform the ſame manœuvre in ſucceſſion; and, when the rear ſhips ſhall have turned about and be in a line with their reſpective columns, and the leaders of the weather diviſions ſhall, by crowding all the ſails, have come a-breaſt of the van ſhip of the lee ſquadron, the evolution will be compleated.

OBSERVATION.

IF the fleet is to ſteer more large than the perpendicular to the wind, it will be eaſily formed, by making the leaders and their columns bear away in ſucceſſion, then putting afterwards the files at the neceſſary diſtance from each other.

ARTICLE XI.

To change from the order of retreat to the order of battle.

AS, in the order of retreat, they fly commonly with the wind aft, the fleet ſhould in that caſe range to the wind all together ſix points

on

on the tack on which they mean to engage; and, immediately after, the ſame van ſhip on the tack of which you have heaved to the wind, ſhall haul cloſe by the wind on the ſame ſide; then all that wing filing off on the ſame courſe ſhall make the ſame movement in ſucceſſion, while the other wing, continuing to run four points large, will come without any difficulty to form the line all at once in the wake of the weather wing, which is at that very inſtant finiſhing to form in the order of battle, in facing the enemy's ſhips which are attacking.*

OBSERVATIONS.

If the fleet which flies is attacked by one detachment only, and is not very much urged on, the wing attacked is to heave to the wind ſix points on the ſame ſide as the enemy; and the van ſhip is at the ſame time to haul cloſe by the wind on the ſame tack, while the ſhips of the other wing ſhall have come all together to the wind on their line, to veer in ſucceſſion in the wake of the wing which is attacked, in filing off at the angular point in order that the enemy may be expoſed to a heavier cannonade, becauſe, as it is eaſy to conceive, they will be kept longer between two fires, ſince the ſhips form ſucceſſively in order of battle, in the wake of the van ſhip.

REMARKS.

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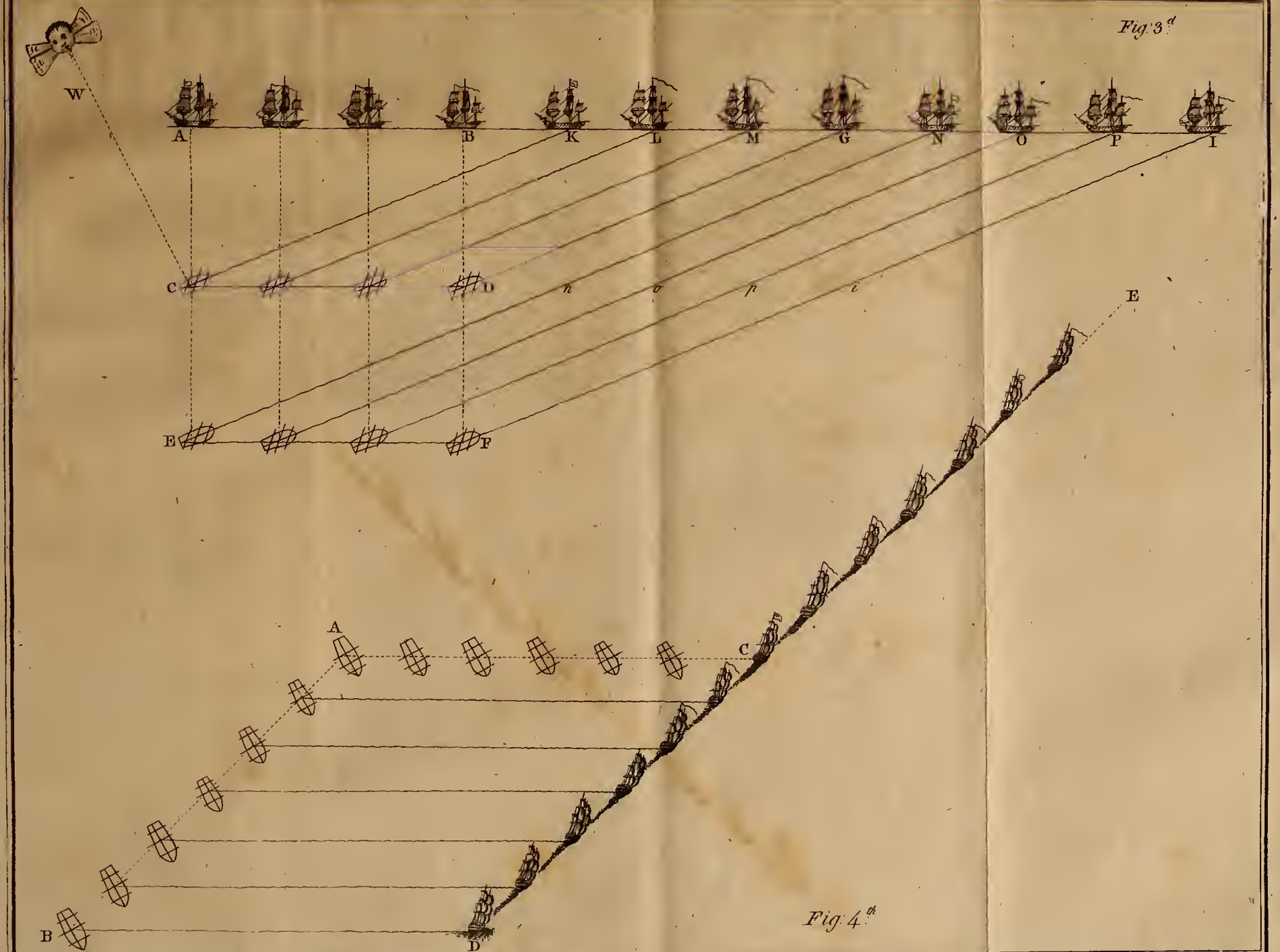
* This being a manœuvre at once eſſential and very ingenious, we ſhall endeavour ſtill more to elucidate it in Fig. 4, Evol. Pl. VIII, where, B A C repreſenting an horizontal ſection of the order of retreat before the evolution, the parallels between A C and B D are thoſe on which the ſhips of the wing A B ſteer, to arrive at their extremities, at which time they are in the wake of the wing A C, the veſſels of which have hauled their wind ſucceſſively from C to E: then, the wing A B being arrived in the wake of the wing A C (the laſt ſhip of which has firſt filed off at the point C), the ſhips of that wing are to haul their wind together, and thus compleatly finiſh the order of battle D E.



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N. C. Goodnight Sculp.

REMARKS.

If you are preſſed on both ſides by the enemy, one of the wings muſt run four points large in the order of convoy, all the ſhips in the wake one of another, without any of the veſſels going out of their line of bearing; while the other wing ſhall ſteer cloſe hauled on the ſame tack, and the ſhips of that wing come ſucceſſively into the wake of the other at the ſame point of the angle, where they are to bear away four points in ſucceſſion: and, when the laſt ſhip is come cloſe to the wind, at the point where the evolution began in the wake of the fleet, which is ſteering four points large in the order of convoy, they are to bring, all at the ſame time, their heads to the oppoſite point of the compaſs, by veering or ſtaying, and, by that mean, they find themſelves at once in the order of battle. However, I cannot help thinking this evolution will always be very difficult to execute, when engaged with an enemy who is really ſuperior, or even with one who ſhall only think himſelf ſuch: whereas, that which we have given before has certainly the advantage of being quicker and more practicable, as it is more regular and more ſimple. Beſides, the ſhips which attack are expoſed to the action of two fires as ſoon as they begin to form in order of battle; becauſe, ſuch of the ſhips as are coming to the wind, preſent their ſides, while, at the ſame time, thoſe who are ſailing four points large play upon them alſo the whole of their artillery.

ARTICLE XII.

To change from the order of retreat to the order of convoy, in one line.

One of the wings is to come all at once cloſe by the wind, on the ſame tack as the line of bearing on which they are formed, in order to file off ſucceſſively at the point of the angle in the wake of the

other wing, the ſhips of which are to run together with the wind four points large, on their line of bearing; and when the laſt ſhip of the weather wing is in the wake of her line, the order of convoy is formed.

If neceſſary to ſail more large, the van ſhip and the reſt of the fleet may bear away more, in ſucceſſion: and, ſhould you not wiſh to keep away ſo much, the ſame ſhips may keep their wind more, and follow the van ſhip ſucceſſively.

ARTICLE XIII.

To change from the order of retreat to the order of convoy, in three columns.

You are to form the order of battle in the ſame manner as has been directed before, in bringing the fleet all at the ſame time to haul up ſix points, and the van ſhip cloſe by the wind on the ſame tack, in order to range in her wake in the line of battle, that the three leaders may then come together on the intended courſe, and the ſhips of each diviſion follow ſucceſſively in their wakes. Then, the order of convoy will be formed in three columns on the ſame tack, becauſe, we ſuppoſe you ſhall have had the attention to form the order of battle on the ſame tack as that you have premeditated to give to the fleet when it is in the order of convoy.

CHAPTER IV.

How to reſtore orders in ſhifts of winds.

ARTICLE I.

To reſtore the order of convoy in one line, when the wind comes a-head more than cloſe hauled.

It is eaſy to conceive that the order of convoy cannot be diſturbed by all the ſhifts of wind, as long as it is more abaft than the

the ſtarboard and larboard lines of bearing; becauſe the ſhips, ſteering large in the wake of each other, can eaſily maintain their poſts, having only their ſails to trim, whether the fleet be in one line or in ſeveral columns. But, if the wind draws more a-head than one of the lines above-mentioned, it is evident, the ſhips being obliged to veer, or pay off, all at the ſame time on the ſame tack, the order will be diſturbed. We ſhall now proceed to give the method to reſtore it on the ſame tack, when the fleet is in one line in the order of convoy. If we ſuppoſe the fleet ſteering large on the ſtarboard tack, and the wind come ſuddenly right a-head, which would immediately throw all the ſails flat aback on their maſts, the van ſhip is to caſt inſtantly to port and bring-to on the ſtarboard tack, while all the reſt of the fleet are to box off, all together and at the ſame time, to ſtarboard, and make all ſail, in order to come with celerity cloſe by the wind on the larboard tack, and get into the wake of the van ſhip, then to tack and take their ſtations ſucceſſively under an eaſy ſail, and bringing-to likewiſe till the rear ſhip, which has a good way to run, be in her poſt.

Should you wiſh to get on the other tack, then the van ſhip is to caſt to ſtarboard, to bring-to on the larboard tack by the wind; then the reſt of the fleet would caſt the other way, to tack afterwards ſucceſſively in the wake of the ſhip which lies-to, and take their ſtation there, as has been ſaid before, with this difference, that, after the reſtoring of the order, you would find yourſelf on the larboard tack.

If the ſudden ſhift of wind be not quite a-head, or if it be ſix points, or between ſix and twelve, the van ſhip is, nevertheleſs, to bring-to on one tack, while the reſt of the fleet, caſting on the ſtarboard, make all ſail to gain her wake, to tack there, and thus regain their ſtations.

The order of convoy may be reſtored by a ſtill ſhorter and more ſimple method, but which will cauſe the fleet to drop to leeward

more than the former does. In the ſame caſe as the laſt, when the wind comes right a-head, the whole fleet is to pay off on the ſame tack, if the ſhips are all on one line, and the rear ſhip muſt bring-to, while the reſt of the ſhips, running five points large (if the wind has ſhifted ſix points beyond the direction of cloſe hauled), will come and bring-to ſucceſſively a-head of the rear ſhip on that of the two lines of bearing which they are to hold, obſerving that ſuch ſhips are to carry a greater and proportionable preſs of ſail, as, being nearer the van ſhip, have conſequently more way to run before they can regain their poſts.

OBSERVATION.

It will always be eaſy to know how many points or degrees the weather ſhips have to run large to get into their ſtations, by adding eight points or ninety degrees to the half of the points or degrees the wind has ſhifted beyond one of the two lines of bearing: and, in regaining your poſts, you will have the quantity of points by which you differ from the firſt courſe you ſteered. For example, if you were ſteering eaſt, and the wind ſhift to that point of the compaſs, it will have ſhifted ſix points beyond one of the directions cloſe hauled, which you would have been able to preſerve on the ſame tack; ſo that, adding half of ſix points to eight, you will have eleven points difference from the Eaſt courſe which you ſteered before, and you will conſequently ſail NW$\frac{1}{4}$N on one tack, to reſtore the order or SW$\frac{1}{4}$S on the other, to gain your poſts cloſe by the wind in a line with the rear ſhip, which bearing Weſt before the ſhift of wind, ought now to bear SSW if cloſe to the wind on the ſtarboard tack, or NNW if poſted upon a bow-line on the larboard tack. Therefore, to regain their ſtations in the line, the ſhips run five points large. Had the wind ſhifted four points only, it would have blown ESE; and the ſhips, taking their poſts on the ſtarboard tack, to the NE of the rear ſhip which is lying-to, would have

have ſteered NNW to fall into their ſtations, and reſtore the order of convoy on the ſame tack.

ARTICLE II.

To reſtore the order of convoy, on three columns, when diſturbed by a ſudden ſhift of wind right a-head.

When the wind ſhifts on a ſudden right a-head, or between the two lines of bearing, the order of convoy is to be reſtored by the whole fleet caſting the ſame way all together, leaving the three rear ſhips of the columns lying-to cloſe to the wind on the tack on which you purpoſe to continue cloſe hauled; while the ſhips of the three columns running large all together on a courſe (to leeward of the firſt), which muſt always be determined by half the number of points or degrees the wind has ſhifted beyond the direction of cloſe hauled, added to eight points or ninety degrees, will bear up with eaſe for their ſtations in the cloſe hauled line of bearing, which they are to hold to the windward ſide of their rear ſhip, where they will arrive ſucceſſively, in carrying more ſail according as they may be nearer to the van, becauſe in that caſe they have a greater diſtance to run.

ARTICLE III.

To reſtore the order of battle on the ſame tack, when the wind comes four points a-head more or leſs.

The rear ſhip is to bring-to; and all the reſt of the fleet are to bear up ſix points large, if the wind has ſhifted four points forward, and conſequently ten points more to leeward than their firſt courſe: then, in proportion as they ſhall come to the cloſe hauled line of bearing on the ſame tack as the rear ſhip which is lying-to, they will

will range again ſucceſſively to the wind in order to bring-to, till the van ſhip has taken her poſt, on the ſame line of bearing.* But as in this kind of evolution the ſhips nearer to the van have always more diſtance to run than thoſe which are nearer the rear, it will be proper for them, as much as poſſible, to accelerate their motions by a preſs of ſail, that no time may be loſt in reſtoring the order of battle on the ſame tack.

REMARK.

To know the number of points which the van of the fleet have to bear up in a ſhift of wind a-head, add eight points, or ninety degrees, to half the points or degrees the wind has ſhifted; and that ſum will give the direction in which you ought to ſteer, in reckoning from your firſt courſe: this principle is the ſame we have made uſe of for reſtoring the order of convoy.

Another Method.

ALL the fleet are to bring-to, the leading ſhip excepted, which is to ſteer ten points to leeward of her firſt courſe, to take her poſt on the line of bearing of the rear ſhip, with reſpect to the wind which is then blowing. But, when the van ſhip, running with all ſail ſet ſix points large, ſhall have brought that which follows her immediately on the parallel of the line of bearing on which the fleet are to form in order of battle, that next ſhip is immediately to veer round ſix points; and when this veſſel is come likewiſe in the line

* The frequency of this evolution rendering a perfect knowledge of it indiſpenſable, we ſhall add a figure which may perhaps aſſiſt, in ſome degree, the conception of ſuch as are not ſo well verſed in naval tactics. In Fig. 5, (EVOL. PL. IX.) let A B be the line taken aback by the wind W, the rear ſhip of which, after boxing off, has brought-to at B: the reſt of the fleet having veered round, ſteer on the parallels to A C between A and B, to bring-to ſucceſſively in their poſt in the line of bearing B C of the rear ſhip at B, when the order of battle is reſtored.

line of bearing of the third ſhip, ſhe is alſo to keep away ſix points large: ſo that, all the ſhips of the fleet coming to file off ſucceſſively as ſoon as they are in lines parallel to the line of bearing, on the ſame tack on which the order of battle is to be formed, will run on parallels and preſerve their diſtances one from another, by coming all together, and at the ſame time, at their reſpective points of the line of bearing they are to hold; and the moment all the ſhips are by the wind, the rear veſſel, which is yet lying-to, is to file, and the order of battle is reſtored.*

Another Method.

ALL the fleet are to veer round at the ſame time, and ſteer on the exact oppoſite point of the compaſs from their former courſe; then the rear ſhip which is now become the van, is to veer and haul cloſe by the wind on the ſame tack as ſhe did before; and all the other ſhips will perform the ſame manœuvre in ſucceſſion: by this mean the order of battle will ſoon be reſtored on the ſame tack.

OBSERVATIONS.

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* To render this more explicit, ſuppoſe the ſhips in their reſpective poſts between A and B (Fig. 6, EVOL. PL. IX.) to compoſe the fleet taken aback by the wind W; there they are to bring-to from E to A in their reſpective ſtations, while the van ſhip at B bears up and ſteers in the direction B C with all ſails ſet: and, when that ſhip, in ſteering on the parallel B C, has arrived at the point D, ſhe is then on the line of bearing E D of the ſecond ſhip at E, who is now to bear up and ſteer on the parallel to B C from E to F; and this ſhip being come to the point G, the third ſhip at H is alſo to keep away on the parallel H I; and when arrived at the point K in following the direction K I, the fourth ſhip is to bear away on L M parallel to B C; and when ſhe has reached the point N, the fifth ſhip at O is alſo to ſteer in the direction O P; and every ſhip, when in the line of bearing of her ſecond, is to execute the ſame manœuvre in ſucceſſion: and, when the ſhip at Q, in ſteering on Q R, has arrived at the point R (which ſhe will do at the very ſame inſtant the van ſhip B arrives at the point C, as do at that very ſame inſtant the veſſels from their former ſituation at E, H, L, O, at the ſame points F, I, M, P), then the rear ſhip at A is to fill, and the order of battle is perfectly reſtored, ſince all the ſhips come in the ſame inſtant to their poſts in the line from A to C.

OBSERVATIONS.

THIS evolution, which inverts the van and rear, is no ways inconvenient, and may be performed in very urgent circumſtances, ſuch as to get a-breaſt of an enemy who wiſhes to avoid an engagement, to double a cape in plying to windward, or to avoid ſome danger.

IF in a ſhift of wind four points forward, you wiſh to reſtore the order of battle on the other tack, all the ſhips of the fleet are ſtill to veer round till their heads come to the oppoſite point of the compaſs; and the rear ſhip, being now the van, is to haul cloſe by the wind on the ſame tack: then all the other ſhips will come and execute the ſame manœuvre in ſucceſſion, to form the order of battle on the tack, more to windward than the preceding, which would put them beſides in a good ſituation to paſs, in veering in ſucceſſion, to the ſame order on the other tack; an evolution very eaſy to execute when the ſquadron is not numerous.

ARTICLE IV.

To reſtore the order of battle when the wind ſhifts twelve points coming from forward.

THE order of battle will not be diſturbed by this event, as the fleet has only to brace ſharp round the other way, to be in the order of battle with the oppoſite tacks on board; and it will be again as eaſy to return to the ſame order on the ſame tack as before, by either tacking or veering in ſucceſſion to haul cloſe by the wind.

REMARKS.

IT muſt be obſerved that, if you know how to take advantage of circumſtances, it will often ſave you a great many movements. Firſt, the wind will never be able to come a-head more than ſix points;

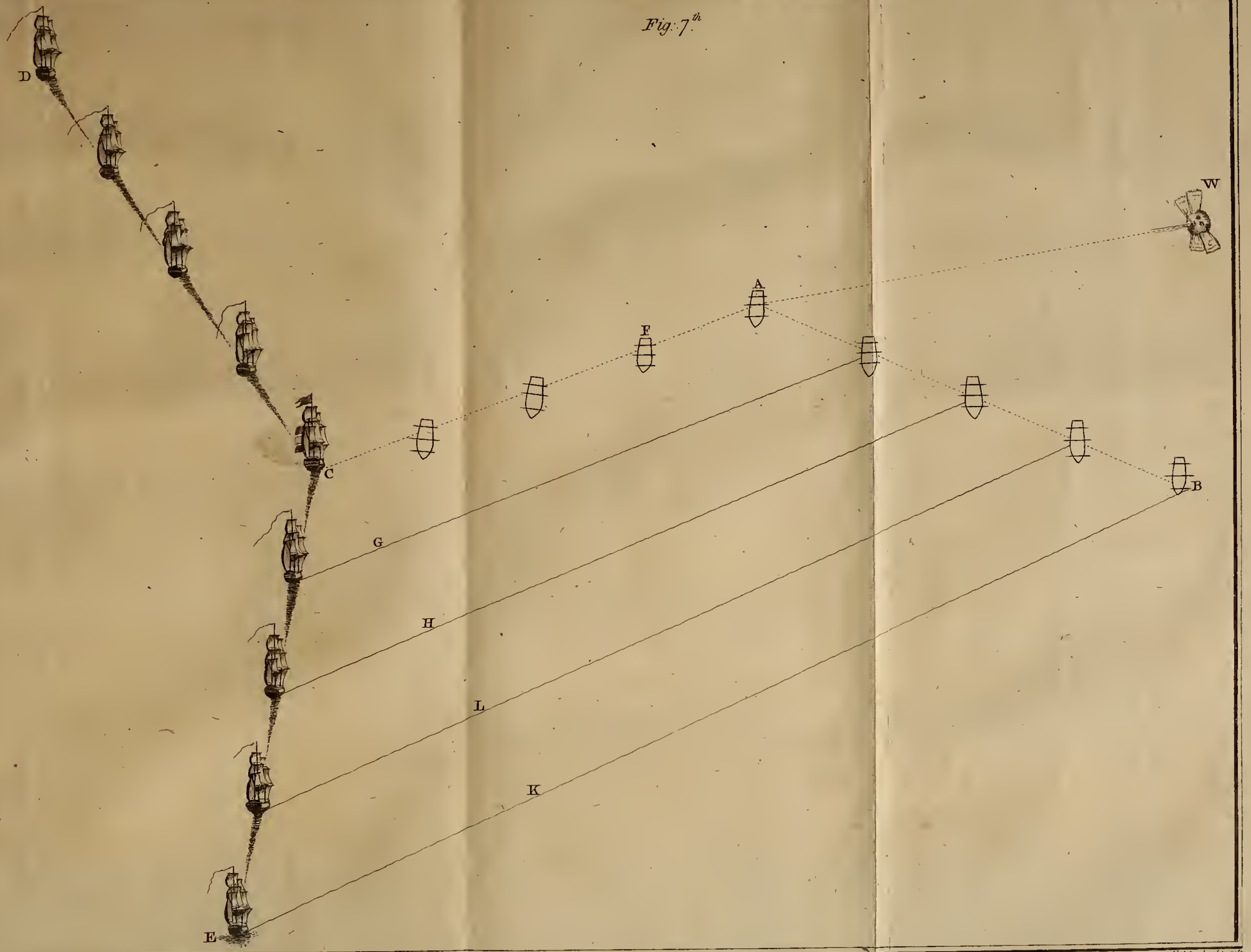
Fig: 5 th

Fig: 6 th

N.C.Goodnight sculp.

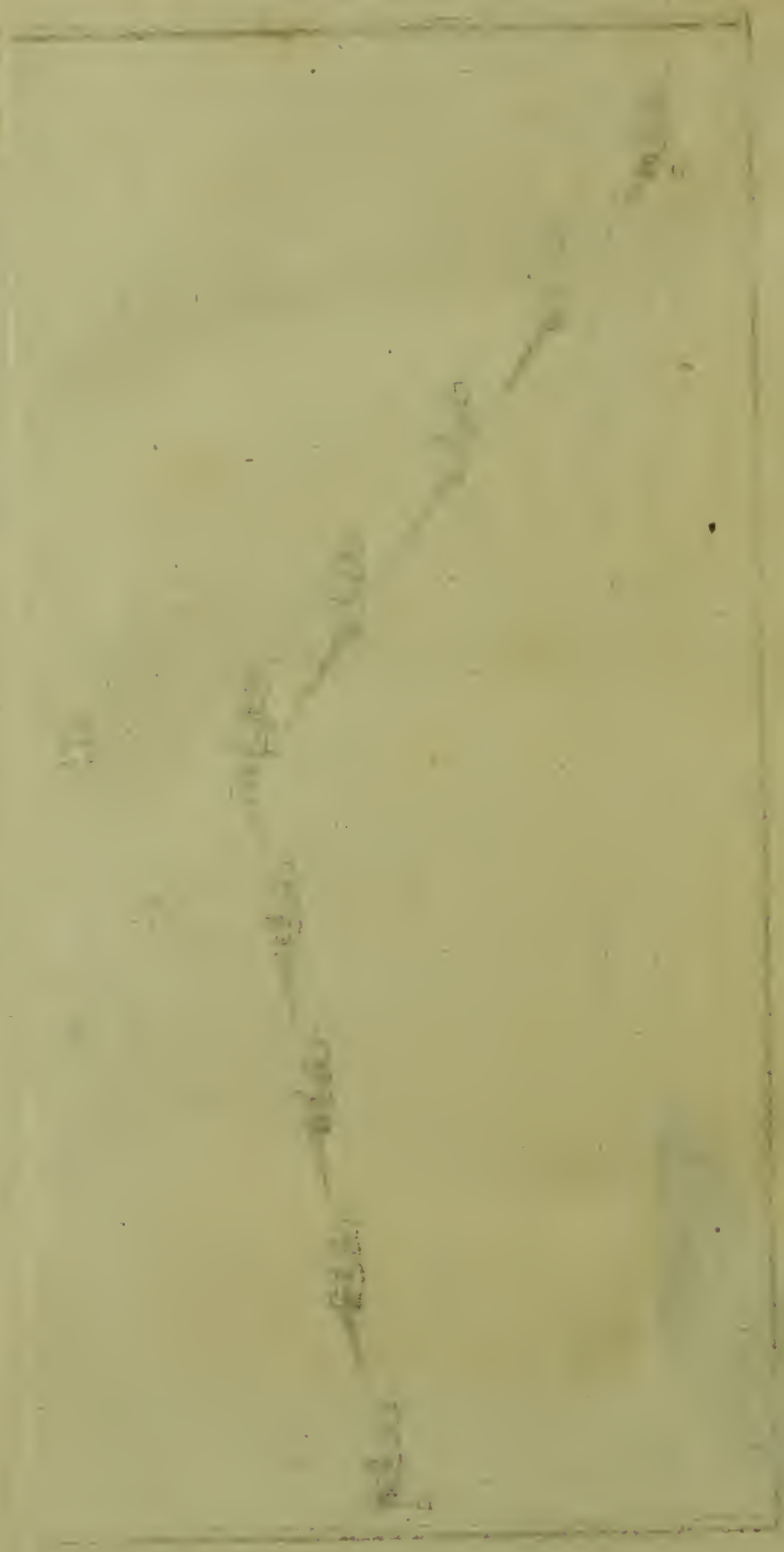
Published 25 th Aug t 1787 by S. Hooper.

Fig: 7.th



N.T. Goodnight sculp.

Publish'd 25.th Augt. 1787 by S. Hooper.



points; for, if it does ſeven points, you are then only to get on the other tack: then, the rear ſhip will bring-to as well as the fleet, if neceſſary; after which the van ſhip will manœuver by bearing away ten points and a half, or, what is the ſame, ſteering large four points and a half, to re-aſſume the order of battle as has been ſhewn before, and in the ſame manner as if the wind had come five points a-head.

SECONDLY, when the wind changes more than twelve points, it does not come from forward but from abaft; for, if the wind were to change fourteen points, you would be obliged to get on the other tack as if it had ſhifted twelve only; and, as you would ſteer then two points large, you would manœuver in that caſe in the ſame manner as if the wind had come aft the ſame number of points.

ARTICLE V.

Another method of reſtoring the order of battle on the ſame tack, when the wind ſhifts on a ſudden four points more a-head.

THE whole fleet is to veer round till the heads of all the ſhips come to the point exactly oppoſite to their former courſe; and the rear ſhip, now become the van by her having got on the other tack, is to haul up in the wind and run four points large; an evolution which is to be followed by the reſt of the fleet, whoſe ſhips are all to get thus into her wake in ſucceſſion. And, when the laſt ſhip is thus arrived in the wake of the head-moſt in the line, all the fleet is to veer together, that they may find themſelves all together in order of battle on the ſame tack as before.

OBSERVATIONS.

IT appears very plain, by the preceding article, that if the wind comes four points forward, the fleet may be reſtored to the order of battle on the ſame tack by the evolution therein deſcribed. But,

ſhould the wind ſhift eight points forward, the fleet muſt then reſume the order of battle on the other tack: for, all the ſhips after being taken aback will veer round to the point oppoſite to their former courſe, and reſume the ſame tacks on board as when in order of battle with the firſt wind, before the change. Then, the rear ſhip having become the van, and hauling the wind on the ſame tack, all the ſhips of the fleet will perform the ſame manœuvre in ſucceſſion, to ſteer four points large in her wake: and, as ſoon as the laſt ſhip ſhall be in her poſt, the whole fleet muſt tack or veer together, and thus will form the order of battle on the other tack. By this laſt movement the van ſhip will regain her poſt.

ARTICLE VI.

To reſtore the order of battle on the ſame tack, when the wind ſhifts on a ſudden eight points forward.

The fleet being in order of battle, and ſuddenly taken aback by the wind ſhifting eight points forward, the ſhips are to veer round all together till their heads be on the point of the compaſs oppoſite to their former courſe. Then, the rear ſhip having, by this movement, become the head, is to haul cloſe by the wind on the ſame board; all the other ſhips will follow in ſucceſſion and range in the wake of the leading ſhip; then, when the laſt ſhip is in her ſtation, the order is reſtored on the ſame tack.

ARTICLE VII.

To reſtore the order of battle when the wind ſhifts aft.

The wind ſhifting aft, the fleet will be in the order of convoy: then, the headmoſt ſhip is to haul her wind on the ſame tack, and all the ſhips of the fleet muſt one after another execute the ſame manœuvre

manœuvre in ſucceſſion; thus, when all the ſhips are cloſe hauled, the order is reſtored.

OBSERVATIONS.

THIS method is very ſimple; and, though it may be a little tedious, it is undoubtedly the only one which ought to be put in practice. For, if the van ſhip, as well as all the ſhips which follow by the wind, carry a preſs of ſail, it will much ſhorten the time of evolution; becauſe, the other ſhips run large as many points as the wind ſhifted, and thus are not long before they are able to haul one after another cloſe by the wind.

IF the wind were ſhifting large four points aft, then the fleet ſhould all together go about at the ſame time; and, the rear becoming the van, the order would at once be reſtored on the other tack, without any of the ſhips running large.

ARTICLE VIII.

To reſtore the order of battle, when the wind ſhifts ſixteen points.

THE fleet being taken aback by a ſixteen points ſhift of wind, they are all to brace about their yards at once, with rapidity, the other way; then the van ſhip ſhall brace up ſharp, making all poſſible ſail by the wind on the ſame board her tacks are on: this evolution being followed by all the ſhips in the fleet which are to perform the ſame manœuvre in ſucceſſion, the order of battle will then be compleatly reſtored and transferred on the other tack.

Another Method.

A FLEET being taken aback by the wind ſhifting ſixteen points, the yards are all to be hauled about with the utmoſt celerity for the other tack, by which means the fleet will be ſailing four points

large: then all the ſhips tacking or veering inſtantly, and all together, they will regain the order of battle on the ſame tack as they were before the ſhift of wind.

Besides the advantage of this evolution over the preceding, in point of celerity in the execution, it brings the fleet more to windward than the other; which, in certain caſes, is of the utmoſt importance, ſince it may procure the means of gaining the wind of the enemy.

ARTICLE IX.

To reſtore the order of retreat, when the wind ſhifts ſixteen points.

The fleet being in order of retreat, and taken aback by the wind ſhifting on a ſudden ſixteen points, all the ſhips in it are to veer, all at once, till their heads come to the point oppoſite the former courſe; to obtain which, the Admiral is to bring-to at the angular point, while the two wings, having veered round, will run before the wind and bring-to likewiſe in ſucceſſion, on the two different lines of bearing of the then blowing wind, and to leeward of the Admiral; obſerving that the van ſhips of the wings are to uſe all poſſible diligence, by carrying a preſs of ſails, to get to their poſts.

Another Method.

The ſhips of the fleet, in this ſhift of wind, are to manœuver all together and at once in caſting to port; and the wing which is to the left of the Admiral is to haul cloſe to the wind with all ſail ſet, in order to bear away ſucceſſively four points large in the wake of the van ſhip, which, in the very firſt inſtant, muſt have bore away that ſame number of points; while the ſhips of the ſtarboard wing of the Admiral run four points large, under an eaſy ſail, on their own line, in order to haul cloſe by the wind in ſucceſſion, in the wake of the firſt line which is filing off; ſo that, when the laſt ſhip of the ſtarboard wing of the prior order ſhall have come to the

the point where the evolution began, and the Admiral is in the center of the two wings where the firſt ſhip of the larboard wing began to veer, the order of retreat will be reſtored, and, by this movement, the ſtarboard wing will become the larboard.

OBSERVATION.

THE order might again be reſtored on the other tack, by caſting all the fleet at once to ſtarboard inſtead of port.

THIS method, it is true, would be longer in the execution than the preceding one, but no leſs ſafe and certain.

ARTICLE X.

To reſtore the order of retreat, when the wind ſhifts leſs than twelve points.

THE wind ſhifting ſeven points, the leading ſhip of the wing which by the ſhift of wind is become the leeward wing, is to veer and run four points large on the other tack, by bracing the yards the other way; and the reſt of the wing having alſo all veered together, are to take one after another the ſame courſe in ſucceſſion, while the Admiral and the ſhips of the weather wing, running on the two lines of the prior order, will come and place themſelves in each other's wake in ſucceſſion, at the points where each wing began to file off; and, when at laſt the Admiral is arrived at the point where the lee wing began to file off, all that wing, as well as the Admiral, muſt haul cloſe by the wind on the tack they are on; while the veſſels of the weather wing, which have placed themſelves in ſucceſſion in the wake of the ſhip at the angle, continue their courſe large to come and haul by the wind ſucceſſively in the wake of the Admiral, whom they ought always to follow in this evolution: ſo that, when the laſt ſhip of that wing is arrived at that point in the wake of the others, the lee wing, having hauled cloſe by the

the wind in the ſame ſpace of time, and all at once, on the other line of bearing with reſpect to the reigning wind, the order is reſtored.*

REMARK.

WERE the wind to ſhift from twelve to fifteen points, the Admiral, in hauling by the wind, would meet the other wing filing off large on the other tack to get into his wake; therefore, to avoid this inconvenience, he muſt continue to run four points large, on the other tack, with the lee wing, till he ſees evidently that,

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* This evolution might, in my opinion, be reduced to a greater ſimplicity by the method we are going to propoſe. By that method the movements will be fewer, and the diſtance which the van ſhip has to run will be diminiſhed more than one third; therefore, it is clear that ſo much time gained, and ſo many manœuvres ſpared in a caſe of exigency, cannot fail being of the higheſt importance for a ſquadron; as it may furniſh them an opportunity of extricating themſelves by the rapidity of their motion. In Fig. 7 (EVOL. PL. X.), for example, if we ſuppoſe A B C to repreſent an horizontal ſection of the order of retreat before the evolution, the wind, having ſhifted ſeven points, muſt blow now from W: then, all the ſhips of the fleet are to bear up ſeven points from their firſt-courſe, ſteering parallel to A C, which is the wing, which by the change of wind is now become the lee one, and the ſhips of which are now ſtanding in the wake of each other, to veer in ſucceſſion at the point C, where the van ſhip, in the firſt inſtant of the evolution, veered round and hauled up four points on the other tack from C to D. By the time the ſhip F of the lee wing ſhall have veered and got upon the other board, the Admiral, with the wing A B (continuing to run on the parallels to A C between B E and A C), will have arrived at the points C, G, H, L, K; then, the wing from C to D (as alſo the Admiral), are all to haul by the wind on the ſame tack; while the ſhips from G, H, L, K continue to run large on their parallels, in order to haul their wind ſucceſſively in the wake of the Admiral (who is at the angle), and take their reſpective ſtations from C to E; after which the order of retreat D C E will be re-eſtabliſhed, and the ſquadron being formed are to bear away again together. By this method, the van ſhip has only to run from B to E on a ſtraight line; whereas, in the former, ſhe went firſt from B to A, then from A to C, and again from C to E, before ſhe attained her poſt.

that, by hauling by the wind, he cannot diſturb the weather wing, the ſhips of which are getting into his wake.

Another Method.

To render the ideas on the ſubject ſtill more general and extended, let the wind be ſuppoſed to have ſhifted nine points: in this caſe, the van ſhip of the wing to leeward ſhall run four points large on the ſame tack, and the other ſhips of that wing will come in ſucceſſion to take the ſame courſe; and, when the Admiral ſhall be arrived at the point where the evolution began, the veſſels of that wing are to veer round all at the ſame time, and bring-to in the direction of the line of bearing, as well as the Admiral who forms the point of the angle. As the other wing to windward have at the ſame time ranged themſelves in the wake of the Admiral, in filing off at the angular point of the prior order, they are now to bear up, all at the ſame time, right before the wind, in order to range themſelves on the other line of bearing of the Admiral, on which the ſhips will ſucceſſively bring-to. So that, when the leading ſhip of this line is poſted, the order will be reſtored with this difference, that the wings change poſition with reſpect to the Admiral, as that which was before to ſtarboard, will now be to port of the angle; but it cannot be attended with any ſort of inconvenience.

The poſition of the wings might be preſerved, by making the van ſhip of the lee wing to veer and run four points large on the other tack, then making the reſt of the wing file off in ſucceſſion four points large alſo, till the Admiral arrives in the wake of that wing, which is then to bring-to, while the weather wing files off four points large in ſucceſſion on the other tack, till all the ſhips of that wing are poſted on the ſame line. By this means, the order of retreat will be reſtored, and the poſts of the wings preſerved with reſpect to the Admiral; but the order of the weather wing will be inverted, and the ſhip which was the van before will now become the Admiral's ſecond.

CHAPTER

CHAPTER V.

How to manœuver a fleet in its various orders without altering them.

ARTICLE I.

Of turning to windward in order of battle.

ALTHOUH a numerous fleet can gain but very little to windward by turning, it is however a manœuvre which often is abſolutely neceſſary, and which never can be better executed than when the ſhips are ranged in order of ſailing on one ſingle line, or in order of battle, which is nearly the ſame: for, then they will be able to tack and tack again, all together or in ſucceſſion, according as the circumſtance of their ſituation may require. For example, if a fleet be turning to windward between two ſhores, with the wind blowing right through the ſtrait againſt them, their different board can be continued but to a certain point; for the leeward-moſt ſhips would ſoon find themſelves cloſe to the ſhore, were the whole fleet to go about all at the ſame time; which will neceſſarily occaſion a number of ſhort tacks, if the ſtrait be deep, becauſe elſe all the weather ſhips would ſoon be in, likewiſe, with the land on the other ſide. But, if the Admiral, at the end of the ſecond board, takes the reſolution to make the fleet go about in ſucceſſion, he will gain to windward as much as if five evolutions had been gone through all together. By this mean, tacking twice will be avoided; and if obliged to turn any time longer, he will not only get more to windward, but alſo loſe leſs time.

IF the fleet have ſea-room, or be turning on a coaſt with the wind parallel to the land, they will gain much more by all the ſhips going about in the ſame inſtant, and plying by ſmall boards, the

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one in the order of ſailing in one line, on one tack, and the other in the order of battle, on the other; becauſe, each ſingle ſhip going about at the ſame time as the others, the fleet muſt get to windward as much as if a ſingle ſhip only was turning to windward; whereas, if the fleet were to manœuver in ſucceſſion, it would ſhorten their ſtretches in ſhore; and, every time they went about, they would loſe ground, becauſe every veſſel which is going to perform her evolution in the wake of that which went about firſt, is obliged to keep away a little, in order to avoid obſtructing the other in her manœuvre, and to preſerve the neceſſary diſtances. Beſides, the firſt ſhips which tack are always obliged to ſhorten ſail, while thoſe in the rear are obliged to carry all they poſſibly can; and, again, this method requires a conſiderable time when the fleet is numerous: if it is not, then the caſe is of no great conſequence. But, however, there is not the leaſt doubt but the ſquadron will gain more to windward by manœuvering all at the ſame time, and continuing their boards both ways as long as poſſible.

OBSERVATIONS.

It is always eaſy to judge very nearly of the time a fleet will require to go about on the different tacks, as we find from experience that nearly ten minutes are required for a line of battle ſhip to go about and be properly trimmed on the other tack, and even no more than ſix, as I have ſometimes been witneſs of.

It is eaſy to conceive that it is not poſſible to beat to windward with eaſe and advantage, in any other form than the order of ſailing in one line, or the order of battle. We are now going, however, to explain the method of doing it in the order of convoy cloſe by the wind.

ARTICLE II.

To work to windward in the order of convoy, in three columns.

A FLEET being ranged on three columns in the order of convoy, the van and rear of the files correſponding exactly in the direction of the wind,* as well as all the ſhips which form the columns, and which are all cloſe hauled on the ſame tack; it will be eaſy to work to windward, if all the fleet tack at the ſame time at the end of each board, as the veſſels can eaſily keep their ſtations in the columns by means of the naval ſquare. In this manner, the fleet in general will gain as much to windward as the worſt ſailing ſhips will do, becauſe the beſt ſailing veſſels will regulate their progreſs by that of the others.

ARTICLE III.

To turn to windward in making the columns go about in ſucceſſion.

THE columns being on the parallels of one of the two lines of bearing, the ſhips of the one correſponding to thoſe of the other exactly in the direction of the wind, with this diſpoſition it will be eaſy for the fleet to work to windward, by going about in ſucceſſion, in making the three van ſhips to tack at the ſame time, and the reſt to perform ſucceſſively the ſame manœuvre at the ſame point, in the wake of their leaders a-head; ſo that there will be always three ſhips at the ſame time in the act of going about; and the time of the evolution will by this method be conſiderably ſhortened.

THE van ſhips of the lee columns, being exactly in the direction of the wind of the leading veſſel of the weather file, will neceſſarily be

* As in Figure 23.

be a-ſtern, and of courſe have more diſtance to run on the other tack after having gone about, than the rear of the weather column, which will conſequently double them a-head, without being expoſed to be interſected by the van of the lee columns, which will paſs them a-ſtern: whence it follows, that a fleet, however numerous, can turn to windward in the order of three columns, provided the diſtance between the columns be ſuch as have been determined by the principle;* for, if they were too cloſe together, the van of the lee columns, on the other tack, would always interſect the rear of the weather file.†

REMARKS.

The van and rear of the columns will be in a very natural poſition; for, the leaders, as well as all the ſhips of the three columns, will correſpond with each other exactly in the direction of the wind: beſides, they can ſee at the ſame time, and by another method, if they are in the line of bearing with their ſeconds a-head and a-ſtern, and will conſequently be ſufficiently able to preſerve their poſts. Secondly, the diſtance of columns will be well enough determined for practice; becauſe, if the van of the lee column, after going about and keeping by the wind on the other tack, have the center ſhip of the weather column about half a point to windward of her, the fleet will be tolerably well poſted for working to windward in ſucceſſion. Thirdly, when all the columns ſhall have come on the other tack, the order will never be diſturbed in the leaſt, ſince the ſhips of the one will ſtill correſpond exactly with thoſe of the other in the direction of the wind, and be cloſe hauled, beſides, on the other line of bearing. In ſhort, I do not believe any thing can be

* See Chap. II, Art. V, p. 239.

† Which have not yet ſtayed.

offered better than this method, which has not always been much approved, though long ago propoſed. We ſhall, notwithſtanding, content ourſelves with it here, without attempting to propoſe any other, which perhaps would be far inferior to it.

ARTICLE IV.

To diſpute the weather gage with the enemy.

That you may not be expoſed in this conteſt for the wind, which never ought to be practiſed but in preſence of the enemy, you muſt take care always to be ranged in the order of battle, or of ſailing on one line, that you may always be in a ſituation to come to action if the circumſtances ſhould require it. Being then in this order to leeward of an enemy of whom you wiſh to get the weather gage, your fleet is to be kept on the oppoſite tack to that of the enemy; becauſe, in that poſition, they will be obliged to edge very much away ſhould they be inclined to come to action, and, by that means, they may loſe the advantage of the wind, which they ſhould not run the riſk of, though, ſtrictly ſpeaking, it may be done without laying the fleet open, as ſhall be ſhewn hereafter.

If your enemy perſiſts in keeping to windward, without coming to action, they will be obliged to keep upon the ſame tack with you, to prevent your getting into their wake, or doubling them by paſſing a-head and to windward, unleſs the whole of the weather fleet be abſolutely excellent ſailers, which is very rare, though not impoſſible. However, as fleets in general ſail nearly upon an equality, it will be impoſſible for the lee fleet to force the other to action, without a ſhift of wind; which is a very common event, which every ſucceeding inſtant may bring about.

It is of the higheſt importance for an Admiral to be acquainted with the poſitions of the coaſts, as well as with the general and particular

reigning

reigning winds in the track he is likely to meet the enemy, in order to take advantage of its revolutions and changes, as well as of the alteration of the tides, as, through ſuch circumſtances as theſe, the weather gage may often be gained, and the fate of a battle decided.

OBSERVATION.

THE lee fleet may turn to windward, and purſue the enemy according to the principles of chaſing, by tacking all at the ſame time, as ſoon as the center ſhip brings the middle veſſel of the weather line exactly on her beam, in order to join them by the ſhorteſt means poſſible, without, however, deviating from the order of battle, or ſailing on one line.

ARTICLE V.

If the weather fleet be inferior, they ought to come to action while they have the advantage of the wind.

THE fleet to leeward, which is endeavouring to get to windward of the enemy, muſt keep upon the contrary tack; but the fleet to windward, which are in order of battle or of ſailing on one line, are to tack all together to get into the ſame poſition as the ſhips to leeward, then bear away ſo as to approach the lee fleet near enough for action, keeping a little a-head of them without breaking the line, to prevent their getting far enough a-head to tack and double the weather fleet's van to windward.

THIS is, in fact, the only reſource the weather fleet have under ſuch circumſtances, unleſs they have ſome place of refuge; for, if obliged to continue long in the preſence of the enemy, they will ſooner or later be obliged to come to action with much greater diſadvantage.

OBSER-

OBSERVATIONS.

If the weather fleet be in order of battle, and the wind draw a-head, the lee fleet, if they be a-head and in order of battle, ought to box off on the ſame tack as before, in order to tack in ſucceſſion in the wake one of another, to reſtore the order of battle in drawing at the ſame time a great deal to windward: this manœuvre may even be a means of weathering the enemy, if the wind ſhould ſhift much: for, they have no other method to regain the order of battle, without loſing much ground; though they will always loſe a great deal with reſpect to the poſition of the enemy to leeward.

If the lee fleet be a-ſtern, and the wind ſhifts aft, while they are on the contrary tack with the enemy in order of ſailing on one line, they ought to tack or veer all together, and at the ſame inſtant; becauſe this ſhift of wind will be a-head for all the ſhips, in reſpect to their tacks on board, and a-ſtern in reſpect to the order of battle. When the van ſhip is full on the other tack, as well as all the reſt in their former order of battle, ſhe ſhall haul by the wind, while the reſt of the fleet run large on their firſt line of battle as many points as the wind has ſhifted aft, to get into her wake ſucceſſively, and reſtore the order of battle in approaching the enemy, and gain the wind of him, and perhaps in doubling him even if the ſhift has been great: for, the only mean they have of reſtoring the line of battle is by the van ſhip hauling by the wind, and the reſt coming into her wake in ſucceſſion. If the ſhift of wind was four points, the fleet to leeward would be obliged ſtill to perform the ſame manœuvre, that they might go about, after a certain time, ſucceſſively to windward of the enemy, who could only in the mean time have tacked all together, to bring their fleet ſuddenly in a line of battle on the other board.

If, when the wind ſhifts aft, you are a-ſtern in order of battle, and the enemy be on the other tack in the order of ſailing, the leading

leading ſhip muſt haul cloſe to the wind immediately, while the other veſſels will come in ſucceſſion and bear away as many points as the wind has ſhifted, in order to perform the ſame manœuvre and reſtore the line of battle. By obſerving this mode of manœuvering, you will approach the enemy, and gain as much to windward of him as poſſible, or get even the weather gage of him entirely, if the wind has ſhifted conſiderably. The rear ſhip of the fleet to leeward may immediately keep cloſe to this new wind on the ſame board, while all the reſt of the fleet, after having tacked together and at the ſame time, will come and place themſelves cloſe by the wind in her wake, where they are again to tack ſucceſſively, in order to follow their rear ſhip, which is now become the leader, and which may break the enemy's line, or at leaſt gain the wind of him. But, to be able to go through this evolution, you muſt have nothing to fear from the enemy; for, the fleet will be obliged to go about twice before the order of battle can be reſtored. The weather fleet ought to keep their wind as cloſe as poſſible, holding the enemy always exactly to leeward of them, by keeping on the ſame tack as he; and if the wind ſhifts a little, and becomes favourable to the enemy which is to leeward, the weather ſhips are then to keep exactly their wind, without caring for the preſervation of the line, unleſs the two fleets be abſolutely very near one another.

ARTICLE VI.

To avoid coming to action when to windward.

The weather fleet having it always in their power to preſerve* their advantage, can but with difficulty be forced to action; becauſe they

* Unleſs the wind changes.

they may always hold the board on which they moſt recede from the enemy; while the fleet to leeward muſt run in the order of ſailing on one line, or in order of battle on the other tack, until their Admiral have the center ſhip, or Admiral, of the weather line, right a-breaſt of him, and perpendicular to his courſe, in order to tack all together and follow the weather fleet by the principles of chaſing. For, if the lee fleet ſtand on one tack till they can weather the retreating fleet, they will ſoon be out of ſight, ſince fleets in general ſail nearly with equal celerity.

OBSERVATIONS.

The weather fleet may fly off in order of battle on the ſtarboard or larboard tack, while the lee fleet purſues them in the ſame manner, that is to ſay, in order of battle likewiſe and on either tack. But when they come to go about, they are to hold the order of ſailing. If the lee fleet is ſo much ſuperior to the weather fleet, as to be able to form a detachment of fine ſailing ſhips, in a ſufficient number to attempt any thing, let it be done; then this ſquadron is to chaſe the flying enemy to winward, in the ſame manner as one ſingle ſhip chaſes another over which ſhe has the advantage in ſailing; while the remaining part of the ſuperior fleet will uſe every poſſible effort to get to windward, as we ſaid before.

By this manœuvre, the detachment of the ſwift going veſſels having joined the enemy, will haraſs and diſturb their movements, beſides keeping them in ſight of the reſt of the fleet, which will then have the ſuperiority in ſailing; for, when you are engaged in an action, or when ſome of your ſhips are diſabled, it is impoſſible to manœuver properly unleſs ſuch ſhips be abandoned; and then it becomes impoſſible to get out of ſight of a ſuperior fleet which takes that reſolution.

REMARK.

If the conſtancy of the winds could be depended upon, the weather fleet might, with impunity, preſerve their advantage in preſence

preſence of the enemy, were he not ſufficiently ſtrong to detach a ſquadron of ſuperior ſailers. But, as nothing is more frequent and common than the variation of the wind, it is always beſt to keep as far as poſſible out of ſight of a powerful adverſary, when you do not find yourſelf abſolutely in a ſituation to fight: and, on the contrary, the fleet inclined to come to action ought to keep in ſight and as near as poſſible, keeping always on the ſame board as the enemy, in order to catch the opportunity of the firſt ſhift of wind to force him to battle.

ARTICLE VII.

To avoid coming to action when to leeward.

THE lee fleet, which is wiſhing as much as poſſible to avoid an engagement, ought to form the order of retreat, to fly from the enemy if they are in view of him, and run on the ſame tack as their chaſer. But, if he is yet out of ſight, and they have intelligence of his approach by their frigates, which are looking out, they may run large from the hoſtile fleet, without confining themſelves to keep the wind exactly aft, unleſs they be in the order of retreat.

OBSERVATION.

THERE are circumſtances when the lee fleet may run with the wind aft, without aſſuming the order of retreat; as, for example, when they wiſh to gain time, or come to action upon the enemy perſiſting obſtinately in his purſuit of them. Theſe extraordinary caſes excepted, a fleet never ought to fly before the enemy, without being in the order of retreat, as the rear is then in the beſt ſituation to extricate themſelves in caſe of accident.

ARTICLE VIII.

To force the enemy to action when you are to windward.

It has already been made evidently appear that, when you are in preſence of the enemy, an engagement is almoſt unavoidable. The lee fleet, which is wiſhing to come at any rate to action, have therefore, in that caſe, need of nothing but patience; for, in keeping always on the ſame tack with the weather fleet, and taking care to have them ſo exactly a-breaſt as to prevent the leaſt danger of loſing ſight of them, you are ready to take advantage of the firſt favourable ſhift of wind to make the attack.

Night is certainly the time when an alteration of courſe may beſt be attempted. But, the lee fleet is to have frigates on the look out, which, by ſignals, will continually give notice of the manœuvre and courſe of the retreating fleet to windward, which, by theſe means, is always expoſed to be purſued without being able to get off unſeen, and muſt, ſooner or later, be compelled to come to action, unleſs they can get into ſome port, or a gale of wind ſhould come to reſcue them by diſperſing both fleets, and thus furniſh the means of retreating in a ſtorm.

OBSERVATION.

It is eaſy to conceive that the lee fleet cannot fail bringing the weather line to action, unleſs the commanding officer of the armament ſhould take the reſolution not to fight but with the weather gage; which will not be eaſily gained without a ſhift of wind, or a very great ſuperiority of ſailing.

ARTICLE IX.

To force the enemy to action when you have the weather gage; or, the way to approach, in the beſt order, near enough for battle.

If the lee fleet keep cloſe to the wind in order of battle, with the deſign of bringing the weather line to action, the fleet to windward

are

are to ſtand on in the ſame manner till they are a-breaſt of the enemy; then, they are all together, and at the ſame time, to bear away, and ſteer exactly ſo as to bring their reſpective opponents in the adverſe line, on the ſame rhomb of the compaſs with them, in obſerving the principles of chaſing, which are to be obſerved by every chaſer to windward. By that mean the fleets will ſoon be near enough to begin the action, in preſenting the bow of each ſhip to her opponent in the order of ſailing, which will be eaſily changed for the line of battle, by all the ſhips hauling cloſe to the wind together, in the moment which precedes the beginning of the action.

OBSERVATIONS.

The fleet to leeward, inclined to engage, might bring-to to prevent loſing time; as, by this manœuvre, leſs time will be requiſite for the weather fleet to join them: then they will fill as ſoon as the action begins, becauſe it is more favourable to a lee line to be advancing a-head; ſince, if a ſhip be diſabled in the weather line (which is obliged to follow with the top-ſails full), ſhe will infallibly drop, and run foul of the next veſſel a-ſtern of her, covered with fire and ſmoak, which may be productive of great diſorder in the fleet, as was the caſe with the Britiſh fleet in the year 1756, in the action off *Minorca*.

As the lee fleet fills and ſtand on cloſe by the wind, it is neceſſary that the weather line ſhould be a-breaſt and parallel to the other, before they bear away to come within the requiſite diſtance for action; in order that the van ſhip of the weather fleet ſhould always keep to windward of the leading ſhip of the lee line, and be guarded againſt ſuch a ſhift of wind as might come a-head; which would not be the caſe if they were a-ſtern of the van ſhip in the lee fleet, which would be able then to double them to windward, as well as the reſt of the line, by tacking in ſucceſſion.

ANOTHER reaſon for the weather line being right a-breaſt of the enemy to leeward, and for every ſhip ſteering on the ſame point in approaching her opponent in the adverſe line of battle, under their lee, is, that the fleets may be placed exactly parallel to each other; for, as the weather line muſt not be a-ſtern, becauſe of the riſk of the winds coming more forward, neither muſt they be a-head of the line to leeward, leſt the wind ſhould come more aft; for then, the lee fleet keeping cloſe by the wind in the wake of their leading ſhip, might, by this ſhift, be as far to windward as the oppoſing fleet, or even get the weather gage of them.

BUT if the weather fleet keep exactly a-breaſt of the other, they will always be in a ſituation to preſerve their advantage, without expoſing themſelves. It is, notwithſtanding, true, that thoſe ſhips keeping more away than the line to leeward, will find themſelves, when come within gun-ſhot, in a very diſagreeable ſituation, with reſpect to the enemy's ſhips, which will have it then in their power to enfilade them obliquely, and fire on their bow as they bear down; which may throw much diſorder among the ſhips of the weather line, which for that moment have it not in their power to fire their whole broadſide at the enemy, who has the advantage of beginning the action.

IF the lee fleet bear up 45°, or four points, to move their order of battle on the other tack and avoid the action, filing off in ſucceſſion in the wake of the van ſhip; the weather line, by bearing up all together, and at the ſame inſtant, eight points, to preſerve the order of battle, cannot fail (both fleets being ſuppoſed to ſail equally) to paſs through the middle of their line, and force them to fight with diſadvantage, if their extent be double the diſtance between the two fleets; for, if they be leſs numerous, they will not be ſo ſoon engaged, becauſe it will be more difficult to cut off any part of them than if the line had four leagues extent, and the diſtance between the fleets only two. A ſquadron, whoſe extent

ſhould

ſhould not exceed two thirds of a league, would (ſuppoſing an equality of ſailing) be able to file off in one half of the time the other would take to join them; but, the weather fleet would ſtill have approached them two thirds of a league.

If the lee fleet bear up four points all together, and at the ſame inſtant, being of equal extent with the line to windward, and their diſtance from each other equal to half the length of one of the files, ſhould the weather fleet bear up at the ſame time eight points, they will approach very near, it is true, the ſtern-moſt of the retreating fleet; but they will not have it in their power to cut any of that fleet off, even with an equality of ſailing: ſo that the only advantage gained by this manœuvre will be an ability of attacking the rear, and bringing it to action.

If the van ſhip and the reſt of the weather fleet had a ſufficient velocity to keep the center ſhip of the lee line on the ſame point of bearing; in that caſe, the leading ſhip may break through the enemy s line about the middle ſhip of the center diviſion; for, ſuppoſing the fleets in order of battle, on the ſtarboard tack, ſteering Eaſt with the wind at SSE, being at two leagues diſtance from each other, both the files being four leagues in extent; the lee line bearing away all together four points large, will run NE, while that to windward, bearing up all together and at the ſame inſtant, will ſteer North, the van ſhip of which will keep the center diviſion of the lee line on the point of bearing NW: as ſhe is ſuppoſed to be able to continue in this poſition, it follows, the van of the weather file muſt cloſe the center of the flying line to leeward, after having run four leagues. The time and diſtance neceſſary to cut off a retreating fleet may always be known, according to the laſt ſuppoſition; becauſe, by the bearing of the two ſhips from the van to the center, we have the baſis of a triangle which will be compleatly formed by the two courſes ſteered by theſe two ſhips, and in which two angles and one ſide at leaſt will always be known; which is

full

full ſufficient to find the reſt, and conſequently to judge the diſtance to be run before cloſing the enemy.

Should the lee fleet get upon the other tack, and run large, ſtill preſerving the order of battle, they will be ſtill ſooner cloſed, and forced to action by the weather fleet, who have only to keep away from eight to nine points on the ſame tack, or run right before the wind.

The weather fleet can always force the lee one to action, whatever movements they make: for, if they run with the wind right aft, in order of battle, they cannot (in ſuppoſing an equality of ſailing) avoid being cloſed, or broken nearly about the center by the weather line, which has only to ſteer two points on each tack nearer the wind than the retreating fleet. So that the rear of the weather file, having borne up no more than eight points, will find, at the end of a certain time, to have approached extremely the center of the retreating fleet, and, in a ſhort time more, will be able to bring their rear to action.

The weather fleet have yet another advantage; becauſe, as their ſhips have the wind on the quarter, they ſail with greater celerity than thoſe of the lee fleet, which run before the wind. The lee fleet being abſolutely determined to fly, has therefore no other expedient left to prolong time, but to combat in the order of retreat, right before the wind, or on the ſame courſe as the purſuing fleet; for, other advantages are not to be depended on, if purſued by a victorious foe, and one of that ſpecies, too ſeldom found, who let nothing eſcape them which is any way favourable to them.

If, from all that has been ſaid, it reſults that it is not poſſible for a fleet of equal force to avoid an action, how then muſt it be with one much inferior? The more numerous has nothing to do but to form a detachment of ſuperior ſailers, which will chaſe ſtrait before them and begin the action, while ſome others approach to finiſh it. Whence we may conclude that, when in preſence of too powerful

powerful an enemy, it will never be poſſible to avoid an action, if he is determined to come to one.

ARTICLE X.

To double the enemy when ſuperior to him, and to leeward of him.

The lee fleet having the ſuperiority in number, ought to endeavour to range exactly a-breaſt and parallel to the weather file, ſo that the van or rear may extend beyond their line, in order to overreach them, by tacking in ſucceſſion to double to windward their van or rear, and bring them between two fires. Provided this manœuvre be properly executed, it will be impoſſible for the ſhips in the weather line, thus preſſed, to continue long in their poſts; for, there is no veſſel cloſely attacked by two others of equal force which can long reſiſt being overcome; ſince it is always in the power of one of them to get into ſuch a poſition as to be able, without much danger on her ſide, to deſtroy the enemy in a very ſhort time.

But the queſtion here to be diſcuſſed is, "Whether the moſt "advantageous evolution is to double the van or the rear?" for, both the one and the other have, in reality, ſo conſiderable an advantage, that either of them may in a very little time determine the fate of a battle.

If the fleet with which you are engaged be to windward, either their van or their rear may be doubled; but, the van may with the greateſt facility; becauſe, if they are engaged by the ſhips a-breaſt of them, thoſe which are advanced a-head will be able, by making all ſail, to get on the perpendicular to the direction of the wind of the van of the enemy, and tack in ſucceſſion to gain the wind of them on the other board, in keeping them to leeward of them: and, when they are come ſufficiently to windward, they are again to go about, in order to keep the two head-moſt ſhips of the enemy's line continually

nually under their fire. If there be two or three ſhips to tack in ſucceſſion and gain the wind of the enemy, they may edge down on the van of the weather line at pleaſure, in keeping themſelves a little to windward of her; and, as that van-guard is already engaged by the other ſhips a-breaſt on the other ſide, ſhe muſt neceſſarily be ſoon diſabled. If they bear up, they muſt drop upon the line with which they are engaged to leeward, while the ſhips to windward ſtill continue to cannonade them. If they attempt going about, in order to attack more cloſely the ſhips to windward, they will be raked, while in ſtays, by their opponents to leeward and to windward, who enfilading them with whole broadſides, which they cannot return, muſt abſolutely put a finiſhing ſtroke to their diſorder. If they make ſail in order to fruſtrate the deſign of the ſhips inclined to double, thoſe with which they are engaged a-breaſt to leeward have only to perform the ſame manœuvre, and keep them under their fire; while the others, after having haraſſed them as much as poſſible, will do their beſt to perform the ſame manœuvre on the ſucceeding ſhips.

The Captains deſtined to double the enemy ought to be men of known ability in the manœuvering of ſhips, as well as of approved courage. They will not be ordered upon that expedition but in a weather fit for ſailing at the rate of three knots an hour: and, for the greater promptitude and certainty of ſucceſs, none but the beſt going ſhips are to be employed in that ſort of manœuvre.

If any of the ſhips in the van of the weather line happen to be diſabled in their maſts or yards, as will undoubtedly be the caſe after having been between two fires, they will drop a-ſtern and run foul of the next which follows, and theſe again of their ſubſequent comrades; at laſt, diſorder will become prevalent, by ſhips running foul of each other, or manœuvering to avoid the ſame accident; ſo that the order of battle will be broke, while, on the other hand, the line to leeward is preſerved with all the advantage poſſible. The

ſhips

ſhips which have gained the wind of the enemy, in continuing their manœuvre will augment the confuſion, and engage, however, no more than they like: and, if by chance or misfortune they ſhould be crippled, it will not certainly be an eaſy matter for them to extricate themſelves. But as they may, on the other tack, drop a-ſtern to windward of the enemy's line, or veer again like him, they muſt extricate themſelves as well as they can, and always advantageouſly enough, if, by doubling the van-guard, they are able to throw it into diſorder.

If the rear of the lee fleet be extended beyond the ſtern-moſt ſhip of the weather line, they will be obliged, if they want to double the rear of the enemy to windward, to make ſail and tack in ſucceſſion; in which manœuvre, the head-moſt ſhip of thoſe deſtined for this ſervice is to go about firſt: then, continuing to keep up a briſk cannonade as they come to the wind, they will go and heave about again a little to windward of the rear of the enemy, in order to bring their ſtern ſhips between two fires; and, ſhould they have the good fortune to oblige them to bear up, they muſt go on ſucceſſively from one ſhip to another, as long as they find they ſucceed in forcing them to give way. Should diſorder take place in the rear of the weather fleet, it will not be near ſo prejudicial to the enemy as if it had happened in the van; on the contrary, it may turn out to be of ſome advantage to them. But the veſſels combating to windward can eaſily withdraw from the fight, by backing a-ſtern, when they find themſelves too hard preſſed.

OBSERVATION.

Before proceeding any farther, it may not be amiſs to remark, that ſhips diſmaſted, or even deprived of the uſe of a top-ſail in the weather line, cannot without great riſk retire from the order of battle (when under neceſſity to do ſo), nor paſs to windward of their rear, in order to refit; for, veſſels ſo circumſtanced cannot

ſtay; and even if they could, their ſtern would be for a great while expoſed to the enemy, who, in that poſition, would ſoon render them motionleſs, by compleatly deſtroying the little rigging they had left.

If ſuch ſhips be obliged to veer, that manœuvre making them approach nearer the enemy, they cannot avoid preſenting their head to their opponent, a ſituation ſo dangerous that nothing more is wanting to compleat their total deſtruction. But, ſuppoſing them able to finiſh their evolution, they will not have it in their power to paſs to windward of their ſecond a-ſtern, without running foul of her: for, one hundred fathoms diſtance between the one and the other ſhips, are not ſufficient to give a diſabled veſſel, which has dropt above fifty fathoms to leeward in veering, ſufficient time to gain to windward the diſtance neceſſary to paſs a-head of the ſhip which immediately follows. Nothing but boats can therefore aſſiſt her, by towing, to get under cover: and yet it will not be executed without undergoing a very heavy fire from the enemy. If it be a van ſhip which is diſabled, being doubled to windward by one or two of the lee line, it will be impoſſible for her to diſengage herſelf: for, the two ſhips which have gained the wind of her will not leave her, nor ſuffer her to receive the leaſt aſſiſtance from the boats or frigates which may be ſent to her relief; and, ſhould the fleet ſhe belongs to bear up and paſs to leeward of her, which is the only manœuvre they have to execute in ſimilar circumſtances, the diſabled veſſel will be ſacrificed, they being unable, without the utmoſt difficulty, to give her the ſmalleſt aſſiſtance; for, every ſhip is engaged by the opponent which is a-breaſt of her, and the leaſt remiſſion of their fire, by fighting on the other ſide to aſſiſt, as they paſs, the diſabled ſhip, would give the lee enemy a decided advantage.

ARTICLE

ARTICLE XI.

To double the enemy when to windward of him.

THE ſhips of the weather line, having extended their van beyond that of the lee file, are to veer, in order to bring the head-moſt ſhips of the enemy's order of battle between two fires. But, let them do as they will, there never can reſult ſo much advantage from this manœuvre as when doubling a fleet to windward; becauſe, the diſabled ſhips can always veer with facility. True it is, they cannot fail becoming at the ſame time the prey of the enemy; for, both thoſe which have doubled them, and thoſe with which they are engaged a-breaſt in the weather line, will always have it in their power jointly to preſs as cloſe upon them as they think proper.

IF the ſhips which have doubled the van of the lee fleet, with which they are engaged, be diſabled, they will be obliged, as they cannot make ſail, to paſs along the lee line; and they cannot eſcape being totally deſtroyed, if they do not bear up before the wind to get out of gun-ſhot; during which manœuvre they cannot avoid being ſtill in a very diſagreeable ſituation.

SHOULD the ſtern-moſt ſhips of the weather fleet be diſabled, in doubling the enemy's rear, they have only, if they want to extricate themſelves, to drop a-ſtern, and let the two fleets advance a-head; and, after having refitted themſelves, they will re-aſſume their poſts.

REMARK.

IT has been propoſed, to avoid being doubled by a fleet ſuperior in numbers, to leave ſpaces in the length of the line, or to place the ſhips at ſuch a diſtance from each other, as to render the length of the inferior file equal to that of the order of battle, which is ſuperior in point of number of veſſels. But neither theſe manœuvres, nor any other of the ſort which might be contrived on that ſubject, will

ever be of any ſervice, if you have to do with opponents of ſkill and ability; for, theſe will always diſpoſe their ſhips in ſuch a manner, that ſeveral ſhips of the inferior fleet will receive the fire of many at once, and will conſequently be obliged ſoon to give way, or ſtrike.*

ARTICLE XII.

To force or traverſe the enemy's line.

This is a manœuvre the lee fleet may execute to gain the advantage of the wind. It is performed by the van ſhip tacking when perpendicular to the direction of the wind of the center ſhip of the weather line you mean to traverſe; then all the file goes through the ſame evolution ſucceſſively, when within gun-ſhot; ſo that you may paſs through the center of the enemy's line, or perhaps a little more towards the enemy's van, to go about again in ſucceſſion to windward of him. But, as he will not be long, without doubt, before he performs the ſame manœuvre, he will thus be able to regain the wind, if you do not force him to give way under your fire before his evolution is finiſhed. The enemy to windward may even cauſe his van ſhip to tack, as well as the reſt of the van-guard to follow in ſucceſſion, as ſoon as the leading ſhip of the lee fleet ſhall have paſſed through his line and be ready to go about, by which means he will bring them between two fires. This manœuvre well executed might perhaps give no little trouble to the ſhip attempting to force the line.

OBSERVATIONS.

This evolution may be performed with advantage, if, by ſome accident or fault in the manœuvering, the center diviſion of the weather

* Or perhaps go to the bottom.

weather line be ſeparated from their van or rear. For example, when the center diviſion to windward is incumbered with diſabled ſhips, then thoſe of the center diviſion to leeward are, with all ſails ſet, to tack in ſucceſſion, and force with promptitude through the weather fleet, to augment their diſorder, leaving their own van diviſion to engage that of the enemy on the other tack.

ARTICLE XIII.

To prevent the line being forced.

When the lee fleet go about ſucceſſively, in order to traverſe the enemy, the whole line to windward are to tack together and at the ſame time, to get upon the ſame board as the enemy, who will neither be able to join nor to traverſe them.

To perform this evolution with advantage, you muſt let ſome of the van ſhips of the traverſing fleet paſs to windward, then go all rapidly about, in order to put and keep them between two fires; thus you may ſucceed in deſtroying them, without their own fleet being able to give them any effectual aſſiſtance.

OBSERVATION.

It is eaſy to perceive from what has been ſaid, that there is little occaſion to fear being traverſed, as ſuch a manœuvre may turn to be more prejudicial than advantageous to thoſe who perform it. Nevertheleſs, it may and ought to be put in practice when the weather fleet leave ſuch vacancies between their diviſions as to allow ſome ſhips of the lee file to be inactive. In this caſe, the ſhips which are without opponents a-breaſt of them are made to tack, with all ſails ſet, in ſucceſſion, and paſs through theſe intervals of the weather line, in order to double the center diviſion, or any other part of it, and bring it between two fires; while the other

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ſhips which are a-breaſt, and on the other ſide of it, cannonade from to leeward.

ARTICLE XIV.

To bring a fleet to an anchor.

A CONSIDERABLE fleet ought to anchor in three parallel lines, at the proper diſtance which the length of the columns generally require. The ſhips being a hundred fathoms from each other, in the line of their head-moſt ſhip, which is to be on one of the cloſe hauled lines of bearing; the van and rear of the columns are to correſpond with each other exactly in the direction of the wind, that they may with eaſe get under way, and form the order of battle with facility, ſo as to be able to diſpute the weather gage with the enemy, if there ſhould come one. As this evolution is to be performed in moderate weather, the fleet being in order on three columns, they are all at the ſame time to bring their ſhips head to wind under their top-ſails, and let go their anchors together, in clewing up the top-ſails, with all poſſible diſpatch, head to wind; putting the foot of the ſails in the tops, and looſening the ſheets before hauling them down; then veering away an equal quantity of cable, to preſerve their diſtances.

OBSERVATIONS.

WHEN it blows ſo freſh as to require the top-ſails being reefed, two cables length diſtance may be kept between the ſhips, and even three if it be likely to blow hard.

IF the fleet do not exceed twenty ſhips, they may anchor on one of the lines of bearing, or parallel to the coaſt, in places where trade winds are common, provided they blow in the direction of the land; for, in all caſes, they muſt be in a condition to get under way at the firſt ſight of the enemy, whoſe approach is never to be waited

waited for at an anchor; becauſe, if it be dangerous for a ſingle ſhip, it muſt be ſtill more ſo for a fleet, the movements of which are interrupted by the difficulty there is in getting with celerity under way ſhips which are moored, and which, in that caſe, are not much able mutually to ſupport one another, as it is abſolutely requiſite in a fleet.

ARTICLE XV.

To get a fleet under way.

All the fleet being ſhort a-peek, the lee column is to get under way firſt, and bring-to all at the ſame time, juſt as they find themſelves after caſting. The center column is then to perform the ſame manœuvre, and caſt likewiſe as ſoon as the other column is brought-to; and both columns will remain in that ſame poſition of lying-to as the lee file, till the weather column which is ſtill a-peek, having weighed, ſhould be alſo under way.

OBSERVATIONS.

The three columns may often be got under way all at once: but, to execute this, the fleet muſt all act together, and with equal ardour; for, the weather ſhips muſt not at any rate be under way before the lee ones.

If it be neceſſary to get immediately in order of battle, the weather columns are at once to bear up two points together, that they may take their poſts in the line of battle a-head of the third column.

If the fleet be moored on a line and head to wind, the rear ſhip may get under way firſt, and haul immediately by the wind; the others, in ſucceſſion, from the rear to the van, can eaſily take their ſtation in her wake, ſo that the rear ſhip will become leader.

If the fleet be moored in a line head to wind, they may all get under way at the ſame time; but the van ſhip is to bring-to, while the

the reſt, caſting the other way, would ſtand on by the wind on the ſame tack on which they have caſt, and come to tack ſucceſſively in her wake, to form the order of battle.

If you wiſhed to be more to windward, the fleet having all at the ſame time got under way, and caſt all on the ſame tack, the van ſhip might heave about under an eaſy ſail; and all the reſt, continuing cloſe hauled on the ſame tack they got under way, will come, in ſucceſſion, in his wake, when they are to ſtay. Obſerve, at the ſame time, the rear ſhips are to carry all poſſible ſail.

ARTICLE XVI.

To put a fleet in a poſition of defence in a road-ſtead.

When a road-ſtead is ſufficiently ſpacious, and the entrance not too much extended, the ſhips are to be moored with ſprings, in two parallel lines from the entrance to the bottom of the bay; the van ſhip ſo near the land that it ſhould be impoſſible for the enemy to paſs between them and the ſhore, and he may be obliged to paſs between the two lines, the van ſhips of which muſt be ſupported by good batteries on ſhore, at the two extremities of the boom, which they muſt take care to have conſtructed from one ſide to the other, when poſſible, or only before the ſhips if it cannot be done otherwiſe. Beſides this, there are to be gun-boats deſtined to poſt themſelves at pleaſure a-head or a-ſtern of the ſhips attempting to force the port. There are alſo to be fire-ſhips moored within the points, that they may be to windward of the enemy after they have got into the port, ſuppoſing them to have been able to force the entrance.

ARTICLE XVII.

Reflections on the beſt method of fighting at ſea.

Boarding ever was, for the French, the moſt advantageous method of fighting. In the Second Part of this Work, I have treated

treated very minutely on the manœuvres of boarding between two ſingle ſhips. In the Third Part, I have entered into the particulars both of the diſpoſitions of the ſhip, and the exerciſe of the crew, which are requiſite to effectuate boarding. There remains therefore for me, in the preſent Part, but to give it as a rule that our fleets and ſquadrons ſhould adopt that mode of fighting which is ſo deciſive for us: in which caſe, this is the method I would recommend to put it in execution.

When, with an equality of forces, you find yourſelf to windward of your enemy, and able to attack him by drawing near, within piſtol-ſhot of him, according to the principle heretofore laid down, and ſo as not to be enfiladed, as we have explained it already, the Admiral ſhould give the ſignal for boarding at the ſame time as he gives that for beginning the engagement, provided the enemy has not begun to fire firſt. Then, each ſhip, under the protection of a ſtrong and well-ſerved fire on its ſide, would manœuver the proper way for boarding her opponent in the hoſtile line, without ſtriking her ſprit-ſail, for fear of diſcovering her intention. This bold and unexpected movement being executed at one and the ſame inſtant, throughout the whole fleet or ſquadron, could not but be very advantageous to the aſſailants, ſhould there even be only a part of that general boarding which turned out ſucceſsfully; becauſe, ſuch of the ſhips as ſhould have met with ſucceſs would, however, take away from the enemy a portion of their force, and ſuch as ſhould have been repelled would have, in all likelihood, done as much damage to the enemy as they might have received, and might alſo, in the end, be ſupported by thoſe of their comrades which ſhould have been conquerors. To conclude, I declare it here then as my firm opinion, that ſuch an attempt can in no wiſe be diſadvantageous, eſpecially if, in ſuch a buſineſs, care is taken never to oppoſe to the enemy any but ſhips of equal force.

When you are inferior in point of number, boarding is again the only expedient you can take; as it is the only reſource of the feeble

to ſhew audacity, and the only glorious manœuvre which can be reſolved upon. It is received as a fact, no longer to be diſputed, that you can be but worſted if you ſpend your time in cannonading.

If you are the ſtrongeſt, boarding is the quickeſt method of putting an end to an engagement. By that mean you ſpare your men and the maſtings of your ſquadron, which is much leſs in danger of being diſabled in ſuch an attack, than when expoſed to your enemy's broad-ſide firing. In a word, I am fully perſuaded that BOARDING is the only method of fighting in which the French can come off with honour, advantage, and glory.*

ARTICLE XVIII.

Of the convoy of merchant ſhips, under the protection of men of war.

To take the requiſite care of a large fleet, there ſhould be in the convoy a number of frigates, which are to be diſtributed a-head, a-ſtern, and on the wings of the fleet, who are always to be kept in the order of convoy on three, four, five, or ſix columns, according to the number it may be compoſed of: ſome other frigates are alſo to be ſent on the look-out, in order to be informed of what paſſes at a certain diſtance, and warned in good time of the approach of the enemy.

If the frigates which are ſent to look out, ſhould diſcover an enemy of ſuperior force, they will make it known by ſignal, and ſteer a different courſe from that of the fleet, in order to deceive the hoſtile ſhips in ſight.

The men of war are to hold themſelves in the order of convoy a little a-head and to windward of the weather column of the fleet; becauſe, in that poſition, they will be able with promptitude to attend

* And why ſhould it not be the ſame for any other nation?

attend wherever their preſence may be neceſſary. The frigates will repeat the ſignals from one to another with celerity and exactneſs, that their purport may, with all poſſible celerity, be made known to the commanding officer, who, on the other hand, muſt not neglect to have all ſuſpicious and neuter ſhips chaſed, and even ſtopped, by the frigates about him, and which are always to be ſupported by one or two line-of-battle ſhips, according to the exigency of circumſtances.

The degree of celerity in the progreſs of the whole fleet will be regulated by that of the worſt-going ſhips, which, however, are to be abandoned when found to cauſe too great a loſs of time; for, ſometimes it is better to riſk a ſmall loſs, than to expoſe the whole by delay.

There will be placed between the columns, ſloops of war, and other ſwift-ſailing light veſſels, to maintain order, and keep the ſhips in their ſtations. Their particular buſineſs will be to get the tardy ſhips to make more ſail, and to oblige thoſe which may be out of their poſt to reſume it; in the evening they will give an account, to the frigates having charge of going the round, of thoſe which have not well manœuvered; and theſe will make their report to the Commodore.

During the night the ſame order will be maintained, except with reſpect to the look-out frigates, which are to be called in within a certain diſtance of the fleet, and which are to be allowed lights as well as the reſt of the men of war. They are to be particularly careful to oblige all ſtraggling ſhips to return to the convoy, and to fire, without heſitating, on all ſtrange veſſels coming from the main ſea, in order to give the alarm. Every night they are to be ſupported on the wings by ſome line-of-battle ſhips.

ARTICLE XIX.

To force the entrance of a port.

THE attack of the entrance of a well-defended port may be conſidered as a piece of the moſt exquiſite refinement, ſkill, and intrepidity, in the art of manœuvering: for, to execute it with any degree of certitude in the ſucceſs, a great knowledge of the ſtrength and ſituation of the place you are going to attack is abſolutely neceſſary, that your diſpoſitions may be made accordingly, by diſtributing, on a plan of attack, the ſhips of the line, frigates, bomb-ketches, and fire-ſhips, to the greateſt advantage poſſible, that not only they may be but little expoſed to the batteries which defend the port, but alſo able, on the contrary, to deſtroy them and facilitate the paſſage. I am well aware that there are ports, the attack of which by ſea may be looked upon as impoſſible, on account of the force of their garriſon, of the elevation and proximity of batteries of all kinds, which may be eſtabliſhed on both ſides of a narrow entrance, which may be farther fortified by a boom, ſupported by batteries at each extremity, as well as by men of war, fire-ſhips, and gun-boats, properly diſpoſed; in ſhort, by all the means which naval and military war can offer to the imagination of officers of experience and ability, who have at heart to defend a poſt with which they were intruſted. But, as, by the help of marine forces, there are a number of ways by which fortifications, of the beſt and moſt ſkilful conſtruction, on ſhore and along the coaſt, may be attacked; we are going to treat in general of that ſubject, without confining ourſelves to a ſingle occurrence, which can never be concluſive for all occaſions, when we come to conſider the almoſt infinite diverſity of places and ſituations which may be met with.

WE have but few examples of harbours being forced when well fortified and defended. We ſhall, however, mention the entrance

entrance* of *Rio-Janeiro*, in *Braſil*, which the celebrated GUAY TROUIN forced in the order of convoy on one line, with his line-of-battle ſhips a-head, and the frigates and ſtore-ſhips bringing up the rear.

THIS action† alone is ſufficient to prove that the entrance of any port, which has no other fortification than batteries of cannon, may at any time be forced, when aſſiſted by a favourable wind to penetrate into it. For, there is not a line-of-battle ſhip but can ſupport the firſt fire of a battery on ſhore, which ſhe with vivacity returns as ſhe paſſes, beſides her being ſupported by her comrades a-ſtern, which begin to open their fire nearly at the ſame time, in ſucceeding one another with promptitude, ſince there ought not to be above one hundred fathoms between a ſhip and her ſecond. Therefore, ſuppoſing there might be even no more than twenty ſail of the line to paſs a battery, it follows, that the rear ſhips, which are always the weakeſt, will not receive a very heavy fire, as the batteries on ſhore muſt be extremely ſhattered after being expoſed to ſo heavy a cannonade, particularly if the ſhips were near‡ enough, and ſerved their fire with ſhot and langrage; for, otherwiſe, they could not be much injured.

AFTER all, guns on ſhore are not ſo conſiderable an obſtacle to the paſſage; for, a ſhip advances with great celerity, and hardly any but

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* The Author ſhould not have forgotten here that moſt eminent tranſaction of the ſame kind by SIR GEORGE ROOKE, at *Vigo*, in the year 1702.

† That of SIR GEORGE ROOKE will prove alſo that neither a boom, nor the moſt able diſpoſition of things, is proof againſt ſteady ability and reſolution, when ſeconded by a leading gale, as the gallant HOPSON, in the *Torbay*, clearly evinced on that occaſion.

‡ A cable's length, or leſs, is the meaſure, in which caſe no fort can withſtand their fire (red-hot ſhot apart). But, if the diſtance exceed a hundred fathoms, the batteries will not be ſo materially damaged.

but the firſt four or five ſhips can ſuffer conſiderably from the enemy's cannon: the very reaſon why ſuch care is taken to employ the heavieſt ſhips in the van, and to take advantage of a fair wind and tide, without letting the land enemy have time to recollect themſelves, and ſeizing the firſt moment of ſurpriſe occaſioned by the ſudden appearance of a fleet, the rapid movements of which cannot be foreſeen to be intended ſooner for one particular part of the coaſt than another, if they are all of a nature to be equally choſen by the fleet for directing the attack upon. But the neck, or narrow entrance of a port, forced under ſail, has interior batteries which are perpetually ſucceeding one another, and the firſt fire of which the firſt ſhips a-head are inceſſantly expoſed to endure. This ſervice is ſevere undoubtedly, and of long ſtanding out; but, after all, it is not ſuch an obſtacle as not to be overcome; and certainly conqueſt cannot be expected without ſtriking a blow; for nothing is ſo natural as to expect to meet with as good a defence as you make an attack. The ſecond batteries muſt then be cleared like the firſt, &c. &c.

If the neck, or entrance of a road-ſtead, harbour, or bay, be ſufficiently wide for two ſhips to enter a-breaſt without encumbering each other, the mouth of the port may be forced in the order of convoy in two columns, the ſtrongeſt and heavieſt ſhips leading, as they can beſt ſuſtain the firſt fire, which, in theſe circumſtances, is the moſt dangerous. Then the fleet is to be formed in the order of convoy on two lines, if the paſſage and the depth of the water permit; becauſe, then the ſhips will be expoſed to the fire of the land batteries but on one ſide only, and by that mean the riſk of every ſhip will conſequently be nearly one half diminiſhed. But, in either of theſe two circumſtances of attack, the Admiral ought perfectly to know the poſt he means to inſult, the forces of the enemy, the diſpoſition of their batteries on ſhore, the face of the country, and the ſituation of the coaſt; that he may be able to judge

judge of the value of the obſtacles he has to ſurmount, and foreſee, conſequently, the diſpoſitions he will be obliged to give his ſhips, and preſcribe beforehand to every one in particular her manœuvre, and what ſhe is to do during and after the attack. He is further to inform them, alſo, that if in the entrance any of the ſhips of the van, or others, ſhould be diſmaſted or ſunk, thoſe which follow next are to paſs a little to windward or leeward of her, without ſtopping, ſtill puſhing their aim, and cloſing the file to fill up the vacancy; warning them again, that in caſe any ſhould be diſabled, ſhe is to retire from the paſſage, in manœuvering in the beſt and moſt rapid manner in her power, that ſhe may not obſtruct her comrades; admoniſhing them all in general, to avoid, above all things, running foul of each other, rather than which they are to run a-ground on the enemy's ſhore, if it can no longer be avoided, after having defended themſelves to the laſt extremity.

When the entrance of a port is ſufficiently narrow to be traverſed by a boom, ſupported by batteries at each extremity, men of war poſted within, fire-ſhips, gun-boats, and bomb-batteries on each ſide; then the attack muſt be carried on in a different manner. Perhaps it will be found neceſſary to warp the ſhips to their ſtations; or they will be able to reach their poſts under ſail, and anchor with their ſprings, which would be more convenient and expeditious than if obliged to be hauled by means of their boats in the night. However it may be, the bombs are to be poſted as near as poſſible to the fortification they are to bombard, and ſo ſituated that the fire from the forts may act as much obliquely as circumſtances will admit, that they may be leſs incommoded in their operations. Ships are to be anchored at the ſame time with ſprings oppoſite to every battery of cannon and mortars, as well as againſt the veſſels which are placed to ſupport and defend the boom. This general attack is to be ſeconded by ſhips ready, with the utmoſt celerity, to take the poſts of ſuch as may be diſabled, and in ſuch a manner, that

that the interval of firing may be as ſhort as poſſible. There are to be gun-boats, ſhips launches, and other boats of the fleet, manned and armed with an Officer each, to aſſiſt the ſhips in quitting or reſuming their poſts, as alſo to tow fire-ſhips clear out of the fleet. Every endeavour is to be uſed to deſtroy the epaulements of the enemy's mortar-batteries, by levelling them and ſilencing their fire; for, they are what is moſt dangerous for the ſhipping, as one bomb of thirteen inches may diſable a ſhip more than an hundred cannon-ſhot. As ſoon as it is perceived that the fire ſupporting the enemy's boom begins to ſlacken, the fire-ſhips and gun-boats are not to fail to attack them with redoubled efforts, in order to break and force a paſſage to the ſhips which defend the boom. The fire-ſhips are always to be placed to windward of the machines attacked; and, if you ſucceed in clearing the entrance, you are to heave the lead to try if there be water enough, or if there are not ſome veſſels ſunk on purpoſe to retard the paſſage of your line-of-battle ſhips, which are immediately to ſail to the attack of thoſe which defend the paſs within the boom. Theſe ſhips are to be followed by the frigates and gun-boats, which are to endeavour to take the batteries in flank. If the mouth of the harbour can be forced in this manner, the forts not yet reduced are to be abandoned, and, continuing your entrance, you make your deſcent, if it has not been made from ſome other quarter by a detachment of the fleet, as might be the caſe, ſince it is always beſt to divide the attention of the enemy, when circumſtances, poſition of the coaſt, and the acting forces, admit of it.

ARTICLE XX.

To make a deſcent in an enemy's country.

DESCENTS are generally made in roads, bays, or inlets, where the ſurf is not conſiderable: for, if the ſea run high, a landing would

would be nearly as impracticable as on a ſteep and rocky ſhore, unleſs effected by ſome lucky and unexpected event. But as we are here to ſpeak of a deſcent made openly, and by force, notwithſtanding it may be vigorouſly oppoſed, it is neceſſary that the flat-bottomed boats ſhould be ſupported, before and during their operations, by the fire from ſome ſhips. Therefore, when the Admiral ſhall have made the neceſſary diſpoſitions for the diſtribution and arrangement of the flat-bottomed boats, on board the men of war and tranſports which may have brought them, he will make them all aſſemble together at a particular place, after he ſhall have well examined the coaſt, and ſettled the plan of his real and feint attacks: then, if along ſhore, and at the place where he means to throw the greateſt part of his forces, he perceives there are barricades and ſmall batteries capable of preventing the landing of his boats, he will ſend line-of-battle ſhips, frigates, and bomb-ketches, to moor with a ſpring againſt every little battery, and every principal fort, to cannonade them with all poſſible vigour, and give them orders, at the ſame time, to redouble their fire where it is his intereſt the enemy ſhould believe he means to make the real attack.

When it is perceived that the fire from ſome of the batteries, in the places attacked, ſlackens, all the boats of the fleet improper for landing troops, are to be detached to another place to make a feint; while one fourth of the boats intended for the real deſcent, followed, within muſket-ſhot, by an equal number of ſimilar boats rowing, and ſailing if the wind permits, will go and range themſelves near the ſhips which cannonade the place where the landing is to be attempted, and by which they are to be afterwards ſupported.

When they are ranged in a line a-breaſt parallel to the coaſt they mean to attack, at about two oars length diſtance from each other, and ſupported at the center and on the wings by gun-boats, which are to take care not to get a-ground; the ſecond file is to form a-ſtern of them, in ſuch a manner that every boat may ſtem within

piſtol-ſhot, for the middle of the interval between the boats of the firſt line, without any of them being a-ſtern of the gun-boats, who are to have room to make a ſtern board when they think proper, to avoid grounding, and to be able to poſt themſelves on the wings while the flat-bottomed boats are landing. Theſe diſpoſitions being carefully made, all this little fleet are to pull together and with rapidity towards the ſhore, attentively preſerving their order till they arrive at the beach. If, in ſpite of the fire of the ſhips, there be troops to receive them from behind their retrenchments, the ſmall pieces every boat carries on her ſtern are to be fired; and the gun-boats, running in as far as poſſible, ſhall ſupport them by every effort in their power, while all the boats run on ſhore, if the enemy give way. Then the ſoldiers ſhall leap out of the boats, the water not being higher than their knees, and form on the ſhore as well as circumſtances will admit, and the veſſels will ceaſe firing, unleſs the enemy be at a diſtance from your troops. If the deſcent ſucceeds in this manner, the boats of the ſecond line are, with the utmoſt ſpeed, to run on ſhore between thoſe of the firſt, and land alſo their troops; and, without loſs of time, the whole reſerve ſhould then be ſent to the place to complete the deſcent.

Should this firſt attack meet with repulſe, you have nothing to do but to feign a ſecond attempt at the ſame place, by adding all the rear boats to thoſe which had formed the former attack, and giving, at the ſame time, the ſignal to the launches of the fleet's ſhips to come and join them, that thereby the enemy may be engaged to vacate the place for which the reſerved boats are to make. When that ſecond attack, the diſpoſitions of which ſhould purpoſely have been dragged a little in length, begins to be engaged, then the boats deſtined for the true and principal attack ſhould be diſpatched, with the grenadiers of the troops on board, on two lines parallel to the coaſts, towards the intended ſpot, under the protection of the fire from the ſhips, frigates, and bomb-ketches, and

ſupported

ſupported on the center, and on the wings of the gun-boats. At the very moment that, under the protection of their own fire a-head, the firſt line of theſe boats would run a-ſhore, the ſecond, with all might and main, ſhould do the ſame, in the interval between the boats of the firſt; that thereby the troops may, in proportion as they form reciprocally, aſſiſt each other in entrenching themſelves: then, all the boats of the mock attack are to be ſent for, to come with all poſſible ſpeed, with ſails and oars, and join with thoſe already landed, and increaſe the forces. The naval officers who command the flat-bottomed boats, muſt take care, as ſoon as the troops are landed, to keep their boats a-float, ready to receive and carry off the ſoldiers who might be repulſed; wherefore, they are to have their heads off ſhore, and their ſwivels ready to fire, if caſe require: as for the ſhips, they are to remain with their ſprings on, till recalled by the Admiral's ſignals.

OBSERVATIONS.

If a fleet, which I ſuppoſe to conſiſt of two hundred tranſports, more or leſs, has no occaſion to be more than two or three months at ſea; there may be put on board each ſhip of three hundred tons, deſtined to carry troops, two hundred ſoldiers, with their officers, proviſions, and ammunition neceſſary for forty days at leaſt, without reckoning the ſhip's company. Every ſhip muſt carry, beſides her long-boat, a flat-bottomed boat of thirty feet long; then, there will conſequently be, two hundred flat-bottomed boats, and a like number of launches on board this fleet.

Such an expedition requires an eſcort of at leaſt ten ſail of the line, ten frigates from twenty to thirty guns, with ſix bomb-ketches, and twenty gun-boats decked: the ſhips of the line muſt have, at leaſt, three boats, including the launch fit for this ſervice, the frigates two, and the bomb-ketches one; which will increaſe the number of boats to ſeventy-ſix. Such a convoy ſhould be ſupported, alſo, by

a fleet of obſervation, of forty or fifty ſail of the line, ſixteen frigates, and ſome fire-ſhips: with ſuch diſpoſitions there are few coaſts which might not be attacked with a moral certainty of ſucceſs.

EACH flat-bottomed boat ought to be lightly built, and ſo diſpoſed as to carry fifty ſoldiers with their officers, a ſmall chaſe-gun, two gunners, ten rowers, a cock-ſwain, and one ſea-officer. According to this diſpoſition, ten thouſand men may be landed at once, in admitting, for premiſes, that the ſecond line of boats may come almoſt at the ſame time, into the intervals between the firſt, and that the coaſt (when the deſcent is made) admits of a hundred boats when they are all joined, being extended a-breaſt of each other, which is no more than ſix hundred fathoms extent, if you allow thirty-ſix feet ſpace for each boat in the line; ſo that the troops on the wings, at the greateſt diſtance from the center, on which they may fall back if requiſite, will not have above three hundred fathoms to march, and re-aſſemble in order to form in ſeveral columns, which can be done with ſo much more advantage, as they may be ſupported by the fire from the ſhips, and that of the gun-boats which are on the wings, and are at liberty to direct their fire according as circumſtances require. At the time of landing, the gun-boats of the center, are immediately to make for the wing which appears moſt in need of their aſſiſtance.

IF the ſhore where the attack is formed does not admit of directing it on many places at once, or of any feints; or if the general ſhould deem it improper to divide the boats to make ſuch mock-aſſaults; all the boats of the fleet, loaded with troops, are to follow within muſket-ſhot, in order to land after the firſt deſcent, at the place appointed by the general officers. The Admiral's majors and major-adjutants ought to be provided with boats of a ſuperior ſwiftneſs, to carry his orders wherever he may think neceſſary, during the action. When the landing is effected, and the troops of the firſt deſcent are poſted, all the boats are to be expeditiouſly ſent back

back to fetch the remainder of the troops, and finiſh the landing; for, in ſuch expeditions it is the rapidity of the execution which decides the ſucceſs.

At landing, in the firſt inſtant of a *coup-de-main*, the fear of damaging the boat is not to be of any conſideration; and they muſt be run ſtem on to the beach, without caring whether they will be ſtranded or not; for it is no more than muſt be expected in thoſe operations which require vivacity and courage, and which always are as many occaſions of triumph for the French Nation, whoſe natural petulancy is an inceſſant incitement to ſeek for glory, in every circumſtance where activity is required for attacking.

CHAPTER VI.

A Plan of Signals.

Signals are to be plain, ſimple, and ſuſceptible of large extent. I do not think there ever were any ſo complete and perfect, in every reſpect, as thoſe which were invented and practiſed by M. La Bourdonaye: he had made uſe of *Pendants*, as being, of all the flags, the moſt eaſy to fix to any part of a ſhip. It was agreed that each *Pendant* would mean a certain particular number; and that ſeveral *Pendants*, meaning each a particular number, being placed one above another, would ſtand as figures. Thus, it was eaſy to know the number of each ſignal, becauſe the value of each *Pendant* was made to depend on its particular colour, as follows:

The Red Pendant was worth	1	The Red, with Blue Tail	6
The White . .	2	The White, with Blue Tail	7
The Blue . .	3	The White, with Red Tail	8
The Yellow . .	4	The Blue, with Yellow Tail	9
The Red, with White Tail	5	The Blue, with Red Tail	0

With

WITH this management, an infinite number of ſignals may be contrived and varied in the ſame manner. You have only to provide three or four pendants of the ſame colour, that the ſame ſignal may be multiplied three or four times running, and produce, for example, ſuch ſignal as 33, or 444, or again 8888, and finally, all the kinds of ſignals, which may be imagined and contrived by means of numbers. Thoſe ſignals are to be hoiſted to any maſt, or yard, according as it is to ſuch or ſuch a ſhip you wiſh to ſpeak; and ſuch parts are to be preferred to hoiſt them on, which are moſt expoſed to view. The upward *Pendant*, for example, may ſignify 1, the next under it will mean 2, the next in deſcending 3, and the next 4. Therefore, having agreed that N° 170, ſhould mean, *Arm your launch for a deſcent*; that ſignal is to be made by hoiſting three *Pendants*, one above another, at the ſame gear; the firſt of which is to be *Red*, the ſecond, *White, with Blue Tail*, the third, *Yellow, with Red Tail*; and then the ſignal will be ſeen in the following form:

Red Pendant	1	170—*Arm your launch for a deſcent.*
White Pendant, with Blue Tail .	7	
Yellow Pendant, with Red Tail .	0	

SHOULD you want to make ſeveral ſignals at a time, and at the ſame gear; then each ſignal is to be ſeparated from the other by a ſmall *red* flag, without a point, which will ſerve as a coma between various ſignals.

IT will be proper to have thoſe *Pendants* of the deepeſt colours in their kinds, ſuch as dark blue, ſcarlet, orpiment, and white.

A TABLE of all the ſignals muſt be compoſed, in the firſt column of which are to be inſerted all the numbers regularly, and in their natural

natural order; in the ſecond column is to be ſet down in the alphabetical order what each ſignal means: as for example,

575—*Abordons l'Ennemi:* that is to ſay, *let us board the Enemy.*
576—*Abandonnez le Vaiſſeau que vous battez:* that is to ſay, *Abandon the ſhip you are engaged with.*

You muſt carefully obſerve to reſerve for the *ſignals of action*, the numbers which are formed with the firſt figures, that they may be indicated with no more than *one* or *two* pendants.

One and the ſame particular colour, is to be given to all the ſhips of each diviſion, by means of which it may, at any time, be known which ſhe belongs to.

None of the national flags, broad-pendants, or colours, which ſerve to mark and diſtinguiſh the diviſions from each other, are ever to be made uſe of for, or underſtood as, a ſignal.

As, when at ſea, one is expoſed to make a great many queſtions, the ſhip, to which thoſe queſtions are made, is to anſwer them inſtantly, by a ſignal of affirmation, or negation, meaning a plain *aye* or *no*, without any preamble, &c. &c.

ARTICLE I.

Of Day-ſignals, when far a-part one from another.

M. la Bourdonnaye, whoſe genius always prompted him to ſtrike out new and uſeful inventions, contrived this ſpecies of signals, for the handineſs of getting himſelf underſtood by a whole fleet, by means of *Pendants* and *Flags*. Accordingly, you are then to make uſe of the four colours, *White*, *Red*, *Blue*, and *Yellow*, becauſe they are all very ſtriking colours; and, to place them by way of ſignals, you are to make uſe of the enſign-ſtaff, the mizen-yard, the mizen top-gallant maſt, the main top-gallant maſt, and the fore top-gallant maſt; obſerving that the firſt figure

figure, that is to ſay, that which is to be put up firſt, in making the ſignals, will be ſignified by the *White* and *Blue* pendants wherever they may be placed; the ſecond will be known by the *Red* and *Yellow* pendants; the third by the *Yellow* and *Red* flags. The *figure* 1, of the firſt column, or that which makes the *hundreds*, in the uſual way of ſetting figures on paper, will be ſpecified by the *White Pendant* at the flag-ſtaff; *fig.* 2, at the mizen-yard; *fig.* 3, at the mizen top-gallant maſt; *fig.* 4, at the main top-gallant maſt; *fig.* 5, at the fore top-gallant maſt; *fig.* 6, by the *Blue Pendant* at the flag-ſtaff; *fig.* 7, at the mizen-yard; *fig.* 8, at the mizen top-gallant maſt; *fig.* 9, at the main top-gallant maſt; *fig.* 0, at the fore top-gallant maſt.

The *figure* 1, of the ſecond column (or that which in the uſual way of writing is reputed the *tenths*), and which muſt be taken down as the ſecond figure in the ſignal, will be expreſſed by the *Red Pendant* at the enſign-ſtaff; *fig.* 2, at the mizen-yard; *fig.* 3, at the mizen top-gallant maſt; *fig.* 4, at the main top-gallant maſt; *fig.* 5, at the fore top-gallant maſt; *fig.* 6, by the *Yellow Pendant* at the flag-ſtaff; *fig.* 7, at the mizen-yard; *fig.* 8, at the mizen top-gallant maſt; *fig.* 9, at the main top-gallant maſt; *fig.* 0, at the fore top-gallant maſt.

The *figure* 1, of the third column (according to the uſual way of writing, where it is reputed the *unites*), and which is to be taken down as the third figure in the ſignal, will be expreſſed by the *Yellow Flag* a-ſtern; *fig.* 2, at the mizen-yard; *fig.* 3, at the mizen top-gallant maſt; *fig.* 4, at the main top-gallant maſt; *fig.* 5, at the fore top-gallant maſt; *fig.* 6, by the *Red Flag* a-ſtern; *fig.* 7, at the mizen-yard; *fig.* 8, at the mizen top-gallant maſt; *fig.* 9, at the main top-gallant maſt; *fig.* 0, at the fore top-gallant maſt.

This once ſettled and agreed upon, you may make as many ſignals as you pleaſe: for example, ſhould you want to ſignal N° 105, you have only to hoiſt the *White Pendant* at the flag-ſtaff; the

the *Yellow* at the fore top-gallant maſt, and the *Yellow Flag* beneath the *Pendant* of the fore top-gallant maſt; in which caſe the ſail is to be hauled down, if it be ſet, as well as the diſtinguiſhing flag. Should the ſignal 297 be wanting, the way to ſhow it will be a *White Pendant* at the mizen-yard, a *Yellow* one at the main top-gallant maſt, and a *Red Flag* at the mizen yard, beneath the *White Pendant*. The ſignal 333 will be executed by a *White Pendant* at the mizen top-gallant maſt, a *Red* one at the ſame maſt beneath the *White*, and the *Yellow Flag* beneath theſe two on the ſame maſt. Finally, were you to ſignal 123, *White Pendant* a-ſtern, *Red* at the mizen-yard, and *Yellow Flag* at the main top-gallant maſt, would be the way.

ARTICLE II.

Of Signals in miſty or foggy weather.

In miſty or foggy weather, ſignals cannot be made otherwiſe but by the firing of the great-guns, and muſkets; ſometimes, alſo, it is done by the ringing of the bells, and at other times by the beating of the drums. The difference between the Admiral's, and their reſpective diviſions, is, in thoſe caſes, made ſenſible, either by the number of guns, or the mode of firing, or that of drumming.

ARTICLE III.

Of Night-Signals.

Night-Signals are to be expreſſed by lights, and gun-firings; on the value of which it muſt have been agreed beforehand: for example, each light will tell for *one*, and each gun-firing *ſeven*, more or leſs, according as may be agreed upon; ſo that, if you want to ſignal N° 27, you fire *two* guns, after having put three lights

wherever you pleaſe, provided they are placed in the moſt conſpicuous place; and that ſignal is to be repeated by the repeating-frigate.—*Six* lights, and *four* guns will, therefore, make 34, and ſo on.

When you wiſh not to be heard at a diſtance, you have but to burn out ſome flaſhes in the pan, or fire ſome muſkets, or ſwivels, inſtead of great-guns.

When you want to know how many ſhips you are together, or give your comrades notice of your being there, it may be done by firing ſquibs, or ſky-rockets: but theſe muſt never be uſed as ſignals, on account of their being ſo liable to miſs; and that, being obliged to ſet fire to ſome others, it would only perplex the ſignal; eſpecially when the gale is ſtrong, and the ſea ſwelled.

The mode of making night-ſignals by means of numbers, is the cleareſt and plaineſt of all; for you have only to reckon the number of lights to be informed of them, though ever ſo far at a diſtance. Should you, on the contrary, content yourſelf with placing your light in ſuch or ſuch a particular place of the ſhip, it would often be very difficult to ſee where they are placed, eſpecially if your ſhip was ſeen obliquely, either from head to ſtern, or from ſtern to head. Now, again, ſhould your ſhip have much pitching, or rolling, it might happen thoſe to windward would have knowledge of your light, while thoſe to leeward would ſee nothing. Hence many miſtakes might ariſe, which will never happen, if you make your ſignals as we have explained it.

F I N I S.

ERRATA.

Page	Line	
4	7	*for* ones, *read* one
6	5	*for* ſurfaces only, when, *read* ſurfaces, only when
ibid.	13	*for* diminiſhed: therefore, *read* ſmaller: ſo that
ibid.	16	*for* theſe being conſidered, *read* as being conſidered only
34	24	*dele* little
	25	*for* top-gallant, *read* top-gallant ſail
	26	*for* fore-top yard, *read* fore-top ſail yard
35,	*penult.*	*for* in the main fore-top ſhrouds, *read* in the fore-top-maſt ſhrouds
66	9	*dele* quite home
69	9	*for* tally, *read* and ſheet home
	21	*for* higheſt, *read* greateſt
71	9	*for* ſwings, *read* rides
	17	*for* enough, *read* caſt ſufficiently
	20	*dele* off
72	26	*for* fore-top ſtay-ſail, *read* fore-top-maſt ſtay ſail
73	4	*dele* up
77	20	*for* windward, *read* leeward
78	13	*for* filled, *read* hauled or braced about
	30	*for* fill, *read* trim
79	3	*for* filled, *read* hauled
80	5	*for* off all, *read* of all
87	5	*for* makes, *read* builds
	Note	*for* to be chapelling, *read* to build a chapel
91	11	*for* fore-ſails, *read* head-ſails
93	8	*for* the top ſail, *read* the fore top-ſail
97	16	*for* a-dry, *read* a-try
103	1	*for* right aft the yard, *dele* the yard
116	22	*for* heaved ſhort, *read* ſhot
129	19	*for* on board, *read* hard
130	1	*for* fatigued, *read* ſtrained
	28	*for* furled, *read* brailed
131	14	*for* ride, *read* come
132	29	*for* caſt, *read* fix
135	31	*for* fatiguing, *read* ſtraining
149	25	*between* ſide *and* of, *add* ſurface
170	4	*for* ſoftneſs or hardneſs, *read* eaſineſs or violence
171	17	*for* hardeſt, *read* moſt violent
174	1	*for* or tally, *read* the tacks or ſheet of
185	2	*for* a-head than a-ſtern, *read* foreward than abaft
	29	*for* to put or tack, *read* to tack or put
201	5	*for* ſhelter at leaſt, *read* ſhelter (at leaſt
	ibid.	*for* ſome, *read* from
	6	*for* bullets, *read* bullets)
212,	*Note, l. ult.*	*for* truſted, *read* thruſted
224	26	*for* Rear-Admiral, *read* Vice-Admiral
	27	*for* broad pendant, *read* flag
232,	*Note*, l. 8,	for *five*, read *four*.
277,	15&23	*for* file, *read* fill
282	21	*for* by, *read* in.

DIRECTIONS TO THE BINDER.

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